

PREFACE TO THE FIRST EDITION

THIS book aims at providing a synopsis of such principles of medicine as are of importance at the present time.

A wider scope has been adopted than merely the classification of the most prominent details of each disease. So far as possible the symptoms have been fully enumerated and briefly explained, and the pathology of the disease and references to the most probable or best-known theories have also been included. At the same time it is hoped that, by means of short summaries and special headings, those data which are of greatest importance have been clearly indicated.

The sections on treatment have been planned to afford a ready reference to a reasonable procedure, and no attempt has been made to give numerous alternative methods or prescriptions.

A full index has been provided.

It is hoped that the book may be of assistance to those who have to revise rapidly their knowledge of medicine in general or of some disease in particular: to the worried student whose final examinations are within sight and to the hurried practitioner from whose ken they have long passed, possibly even to the teacher with a lecture to prepare and to the examiner who, for the purposes of a *viva voce*, desires to renew for a brief period his knowledge of any of the essential details of medicine.

The 'synopsis' cannot replace a text-book to the student, and any attempt to make it do so will inevitably lead to failure.

The general arrangement of the book follows that of Osler's universally known *Principles and Practice of Medicine*, and for their kind permission to do this our special thanks are due to the publishers, Messrs. D. Appleton and Company. Exceptions to this occur in various portions of the book, and many alterations and additions have been made. The section on Diseases of the Nervous System has been rearranged in accordance with the advice of a well-known neurologist. Considerable changes have also been made in the sections on Diseases of Metabolism, of the Alimentary System, of the Blood, and of the Circulatory System.

I have frequently referred to and am indebted to numerous works, especially to the large systems of Allbutt and Rolleston, and of Osler and McCrae, and to the monographs of Judson Bury

A SYNOPSIS OF MEDICINE

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SEVENTH EDITION, REVISED AND ENLARGED

BRISTOL: JOHN WRIGHT & SONS LTD.

LONDON: SIMPKIN MARSHALL LTD.

1939

Erysipelas—Symptoms, *continued*.

LOCAL SYMPTOMS.—(1) Skin red, hot, smooth, tense, and cedematous; (2) Blebs common; (3) Definite spreading red edge develops; (4) Advances at the edge, while centre fades. Face and features swell enormously, especially eyes, lips, and scalp. Neck swollen and glands enlarged. Pus may form under scalp. Mouth, throat, and larynx may be involved.

CONSTITUTIONAL SYMPTOMS.—*Temperature* high: usually no remissions. Symptoms severe in old, alcoholic, or debilitated subjects. *Delirium*, especially in alcoholics or when scalp is involved. Albuminuria usual.

Complications.—Oedema of glottis serious. Meningitis rare, even when meningeal symptoms are present. Rarely: pneumonia, pyæmia, septicæmia.

Course and Prognosis.—Self-limited. Spreading edge dies out. Temperature often falls about fourth to fifth day. Mortality very low if previous health good.

Treatment.—

ISOLATION AND DISINFECTION NECESSARY.

GENERAL TREATMENT.—Light diet. Much fluid. Brisk purge. Alcohol freely. No incisions, unless pus formation.

LOCAL TREATMENT.—Ichthyol ointment (1-4 lanolin) with lint mask. In mild cases, cooling applications sufficient: cold water or evaporating lead and opium lotion. Tincture of iodine may be painted on skin, $\frac{1}{2}$ to 1 inch from spreading edge (to promote leucocytosis).

DRUGS.—See TREATMENT OF SEPTICÆMIA, p. 35.

FOR HYPERPYREXIA.—Antipyretics (phenacetin, etc.); or, if necessary, bathing, etc., as in enteric.

IN CONVALESCENCE.—Tonics and fresh air necessary.

VACCINES AND ANTISERA.—Not of proved effect.

CHAPTER IV.

DIPHTHERIA.

A specific infectious disease due to the Klebs-Loeffler bacillus, and characterized by local symptoms due to a fibrinous exudate, usually on mucous membranes of fauces or larynx, and by constitutional symptoms due to toxins produced by the bacilli at the site of exudate.

Etiology.—

GEOGRAPHICAL DISTRIBUTION.—Almost universal, but most prevalent in temperate and cold climates.

SEASON.—Especially in last quarter of year. Highest in dry years. In England, slight fall in August, and maximum in October and November.

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17 JUL 2001

~~First Edition, July, 1920.~~

Second Edition, December, 1921.

Third Edition, December, 1922.

Reprinted, March, 1924.

Fourth Edition, September, 1925.

Reprinted, June, 1926.

Reprinted, November, 1927.

Fifth Edition, September, 1930.

Sixth Edition, August, 1934.

Seventh Edition, January, 1939.

PRINTED IN GREAT BRITAIN BY
JOHN WRIGHT AND SONS LTD., STONEBRIDGE HOUSE, BRISTOL.

RESPIRATORY SYMPTOMS (for prescriptions, *see* ACUTE BRONCHITIS).—In early stage of dry cough give expectorants. Cease when cough becomes loose, as expectorants upset the stomach, and also aid accumulation of secretion in tubes. Inhalation of tinct. benzoin. co. (3j to 1 pint) often loosens cough. If robust patient, emetic often effective. When secretion loose, give belladonna. If cough becomes chronic, heroin may be given, but an effective cough must not be stopped.

CIRCULATORY SYSTEM.—Treatment of cardiac failure as in lobar pneumonia. In old persons, give stimulants freely; press food, and avoid cold.

CONVALESCENCE.—Treatment of great importance. Fresh air, tonics, and full diet. Chills to be avoided.

GENERAL AND LOCAL PNEUMOCOCCAL INFECTIONS.

Pneumococci may produce infections and lesions without involving the lungs. These may be general septicæmia, local lesions, or both. In some cases, especially when severe, various degrees of pulmonary involvement finally appear.

1. **General Septicæmia.**—Symptoms of acute septicæmia, rapidly fatal, and only diagnosed by blood cultures.
2. **Local Affections.**—Primary pneumococcal infections have, in general, a high mortality. Any organ or site may be involved. The most important and frequent affections are:—
 - a. **OTITIS MEDIA.**—Commonest lesion.
 - b. **PLEURISY.**
 - c. **ARTHRITIS.**—May subside or suppurate.
 - d. **PERITONITIS.** (*See* PNEUMOCOCCAL PERITONITIS.)
 - e. **MENINGITIS.** (*See* PNEUMOCOCCAL MENINGITIS.)
 - f. **NEPHRITIS.**—Symptoms of acute infective nephritis.
 - g. **ACUTE OEDEMA OF THE LUNGS.**

Also: Perinephritic abscess, pericarditis, endocarditis, infections of accessory nasal sinuses, and others.

CHAPTER VI.

CEREBROSPINAL FEVER.

(*Cerebrospinal Meningitis. Spotted Fever. (In infants) Posterior Basal Meningitis.*)

An acute infectious disease, occurring sporadically and in epidemics, caused by the meningococcus, and characterized pathologically by purulent inflammation of the meninges of the brain and cord.

History.—The history previous to 1805 is unknown: possibly confused with typhus. The disease occurs in Central Africa, and may have been imported by Napoleon's army from Egypt.

WEICHSELBAUM, 1887, described the *meningococcus*.

STILL, 1898, isolated the diplococcus in posterior basic meningitis.

PREFACE TO THE SEVENTH EDITION

SINCE the publication of the Sixth Edition in September, 1934, the advance of knowledge has thrown light on many questions of practical importance in the science of medicine.

The greatest advances have been in the knowledge of Hormones and Vitamins. Regarded but a few years ago almost as abstract conceptions, their isolation, identification, and synthetic preparation now proceeds apace. The new insulins have also materially altered the treatment of Diabetes. Sections dealing with these subjects have been extensively revised.

The application of the great discoveries on the mode of production of Anæmia has resulted in further advances in knowledge of Diseases of the Blood. A large part of this section has been rewritten.

Articles which have been entirely or extensively rewritten include Undulant Fever and Brucella Abortus Infections, Tularæmia, Yellow Fever, Typhus, Acute Poliomyelitis, Glandular Fever, Acidosis, Alkalosis, Treatment of Peptic Ulcers and Hæmatemesis, Gastro-jejunal Ulcers, Gastroptosis, Diaphragmatic Hernia, Hirschsprung's Disease, Amœbic Hepatitis, Bronchiectasis, Uræmia, Pyelitis, Subacute Bacterial Endocarditis, Congenital Affections of the Heart, Functions of the Pituitary and Suprarenal Bodies, Subarachnoid Hæmorrhage, Dwarfism and Infantilism, Rheumatoid Arthritis, and Fibrositis.

The new article on Duodenal Obstruction includes both Chronic Duodenal Ileus and Acute Dilatation of the Stomach. Hæmoglobinuria has been rewritten and transferred to the Section on Diseases of the Blood.

Numerous changes have also been made in other articles.

New articles have been added on Onchocerciasis, Lymphogranuloma Inguinale, Pyorrhœa Alveolaris, Acute and Chronic Glossitis, Uveo-parotitis, Ulceration of the Pharynx, Peptic Ulcer of the Œsophagus, Carcinoma of the Colon, Regional Ileitis (Crohn's Disease), Polyposis of the Colon, Lesions of Meckel's Diverticulum, New Growths of the Larynx, Diseases of the Trachea, Bronchial Obstruction, Diseases of the Diaphragm, Diseases of the Pineal Body, and Anorexia Nervosa.

Regional Ileitis is the only new disease 'discovered' since the last edition. The omission of Carcinoma of the Colon from

Amœbic Dysentery—Symptoms, *continued*.

severe, but little toxæmia; tenderness often localized to cæcum or sigmoid; pyrexia usually only with hepatitis (liver palpable). Loss of weight variable. Interval between attacks weeks to years.

MILD FORMS.—Common. Often recurrent sudden diarrhœa only.

Chronic form not infrequent with no diarrhœa, obstinate constipation, lassitude, depression and abdominal discomfort; may be intermittent attacks.

LATENT FORM.—Not uncommon. Complications may be first manifestation.

Progress.—Acute form and attacks rarely may resist treatment and be fatal, but initial mortality is low. Subsequent progress may be: (1) Long convalescence with alternating diarrhœa and constipation; (2) Chronic forms; (3) Complications; (4) Carriers.

Character of Stools.—Except in acute forms, number often 3 or 4 daily, rarely exceed 12. Mucus, blood, and fæcal matter mixed. Acid reaction. *Microscopic*: Cysts of *Entamœba histolytica* (see p. 92); few macrophage cells.

Diagnosis.—See **BACILLARY DYSENTERY**. Also from intestinal neoplasm, cholecystitis, and chronic intestinal lesions. *Sigmoidoscopy*: Ulcers often visible in sigmoid: remove material for examination. *Radiographs*: Little assistance.

Complication and Sequelæ.—Important.

LIVER ABSCESS.—See **ABSCESS OF THE LIVER**.

LOCALIZED PERITONITIS.—Not uncommon in chronic cases, especially over thickened intestine—e.g., cæcum. May be confused with appendicitis, but operation useless.

PERFORATION AND PERITONITIS.—Usually in later stage of severe attacks. Mortality high owing to extensive lesions of intestine. *Hæmorrhage* rare, but may be fatal.

COLON.—Never stricture. May be dilated.

APPENDICITIS.—Not uncommon.

Other complications as in bacillary type, but no arthritis.

'Carriers'.—Cysts of *Entamœba histolytica* present in stools. May have had severe attack, but often slight or none. Should receive treatment, but may continue to pass cysts permanently.

Treatment.—General treatment, diet, etc., as in bacillary dysentery, but saline treatment with sodium sulphate is contra-indicated. Serum is valueless, but harmless.

EMETINE.—Essential in all forms of *Entamœba histolytica* infections. Rogers introduced the drug. Is intestinal irritant, causing nausea and vomiting and often diarrhœa: if dosage excessive, also cardiac disturbances and may be neuritis and paralysis. Patient must be confined to bed. Toxic to young children. For vomiting, give tinct. opii.

EMETINE HYDROCHLORIDE.—Hypodermic or intramuscular injection. Dosage: gr. j in 1 c.c. distilled water daily for 12 injections. May be repeated. Very effective in initial

previous editions is somewhat remarkable. Correspondents have been kind enough to call attention to many points, but I was unaware of the omission of this important condition until a few months ago.

A German translation from the Sixth Edition, by Professor Emil Schwarz of Vienna, was published in January, 1938, and I would like to express my thanks to him for the great care which he has devoted to it. The translation is nearly literal, but Professor Schwarz naturally used his discretion to make such changes as were necessary, and I am greatly indebted to him for calling attention to many points. The additions in the German translation are almost confined to treatment. It is interesting to note the number of proprietary drugs which are included. Under Heart Failure there are several pages of such drugs, with descriptions of their composition and dosage. Our own text-books and even our Pharmacopoeia are possibly lagging too far behind the advances of synthetic chemistry, and the fear of advertising a particular brand should not in future bar the mention of such preparations of established value.

The alterations have resulted in the addition of about forty pages to the text. The index, too, has been entirely re-written, and now occupies an additional 32 pages.

I am indebted to many correspondents and reviewers who have called attention to various slips and errors.

Many text-books and monographs have been consulted. I refrain from naming them as I have not always adopted their views. I would, however, express my indebtedness to Professor L. J. Witts and Drs. L. E. H. Whitby and C. I. C. Britton, whose communications I have followed frequently, though not invariably, in rewriting the section on Diseases of the Blood.

I wish again to thank Dr. F. S. Hunter, who has read the proofs of each edition, including the original publication. His extensive knowledge and keen eye have been invaluable.

Anthrax in Animals, continued.

MORBID ANATOMY.—*Spleen* greatly enlarged. Lymphatic glands enlarged. Lungs congested. Cloudy swelling in all organs. Bacilli are present everywhere, especially in spleen, in capillaries, and lymphatics.

SUSCEPTIBILITY.—Varies greatly in different species. The large herbivora, sheep and cattle, highly susceptible, although certain Algerian sheep are immune. Adult carnivora and white rats are immune.

Man has considerable immunity.

MODE OF INFECTION.—Numerous bacilli are deposited from the mucous discharges and form spores; hence a pasture may remain infective for years and the spores be scattered by wind and water. The spores pass through the stomach, resisting the gastric juice, and thus animals are attacked from the intestines. Buried carcases are a possible source of infection. Pasteur believed that earthworms may thus be a factor, but Koch disproved it.

PASTEUR'S METHOD OF IMMUNIZATION.—Pasteur attenuated cultures by growth at 42°, and immunized animals by inoculation. The method is practised on a very extensive scale, and is of extreme value.

Anthrax in Man.—Almost confined to workers in hides, hair, and foreign wools; very rarely in butchers; occasionally from infected shaving brushes. The clinical symptoms vary according to mode of inoculation, external or internal.

The following varieties are usually described:—(1) *Malignant pustule*, or cutaneous anthrax. An erysipelatous anthrax, or anthrax oedema, also occurs rarely. (2) Pulmonary anthrax, or wool-sorters' disease. (3) Gastro-intestinal anthrax, or mycosis intestinalis; rare. Malignant pustule forms 95 per cent of all cases.

1. **MALIGNANT PUSTULE.**—Site of inoculation most commonly face, back of neck, and arms: being rubbed by hides carried on back. Incubation period probably 2 to 7 days. Onset with *itching* at site of inoculation. *Papule* forms in 1 to 3 days: rapidly becomes a vesicle containing clear or bloody fluid and surrounded by area of congestion: *central necrosis* occurs. Typical *malignant pustule* present in 1½ to 3 days—viz., central black eschar surrounded by a ring of vesicles, and outside this an area of congestion. The pustule never contains pus. Subcutaneous oedema spreads from the pustule. Lymphatic glands in area swell.

GENERAL SYMPTOMS.—Slight in early stage, but in absence of recognition and of removal of pustule rapidly become severe, with malaise, faintness, weak pulse, and collapse. *Temperature* is high. Severity of general symptoms is out of proportion to size of local lesion. Pain usually slight. Septicæmia develops as in internal forms, but modified. Death occurs in three to five days in absence of treatment. The mind is usually clear to the end.

Tuberculosis—Tuberculous Meningitis—Symptoms, *continued*.

3. Pupils dilated and other signs as last stage. Eyelids close partially.

Pulse rapid. Diarrhoea. Incontinence complete. May be typhoidal state. Temperature low, rising before death.

DURATION.—Three weeks common. From two to six weeks.

VARIATIONS.—(1) Acute form fatal in a few days with abrupt onset. (2) Acute form supervening on tuberculous tumour presenting symptoms of cerebral tumour.

Symptoms : Special Features.—

PULSE.—Rapid at onset, becomes slow and irregular as intracranial pressure increases (less marked under 5 years) : finally rapid as heart fails.

TEMPERATURE.—High in first stage (103°), then falls (100°), may rise or be hyperpyrexial (106°) in third stage.

OCULAR CHANGES.—

PUPILS.—In first stage contracted : then dilate as intracranial pressure increases. Often unequal. On exposure to light may 'oscillate', contracting and immediately dilating. Later, dilatation increases and reaction to light is absent.

EXTERNAL MUSCLES.—(i) Squint : often early sign. (ii) Incoordinated movements : slow independent movements of the two eyes from side to side. Important sign, but may occur in healthy young children during sleep. (iii) Ptosis.

OPTIC NEURITIS.—Rarely intense : edge of disk blurred and vessels curved. In early stage presence usually doubtful.

CHOROIDAL TUBERCLE.—Very rare.

Conjunctival and corneal reflex lost in last stage.

MOTOR SYMPTOMS.—

CONVULSIONS.—May occur : (i) At onset of first stage : solitary general convulsion ; (ii) In second stage : very variable, often local spasm of one limb, etc., from cortical irritation ; (iii) In third stage : may be general. Rigidity, paralyses, or contractions may follow.

PARALYSES.—Occur in second and third stages. Sometimes transient. (i) Hemiplegia : either from internal capsule or cortex (from affection of branches of middle cerebral artery) ; (ii) Monoplegias : various. Of cranial nerves, most often 3rd and 7th : may be syndrome of Weber.

RIGIDITY.—Invariable : often follows convulsions.

VARIOUS.—Tremors : athetoid movements : local spasms.

KERNIG'S SIGN.—Usually present. Absence of no importance.

Babinski's sign occasionally present. Knee-jerks variable ; increased or diminished.

DECUBITUS.—In first two stages lies on side, elbows and knees flexed. If moved to back, returns to side. In third stage may lie on back.

Special Reactions.—

CEREBROSPINAL FLUID.—Under pressure. Fine cobweb coagulum forms on standing. Character diagnostic, i.e. : (1)

on *Diseases of the Nervous System*, of Rolleston on *Diseases of the Liver and Gall-bladder*, of Lewis on *Clinical Disorders of the Heart-beat*, and of Mackenzie on *Diseases of the Heart*. Among others I have also referred to Manson's *Lectures on Tropical Diseases*, Daniels' *Tropical Medicine and Hygiene*, Muir and Ritchie's *Manual of Bacteriology*, Campbell Thomson's *Diseases of the Nervous System*, Sequeira's *Diseases of the Skin*, Pantón's *Clinical Pathology*, and Warren's *Text-book of Surgery*. Other sources have, I trust, been acknowledged in the text.

The special arrangement of headings and types is on the same system as in Hey Groves' *Synopsis of Surgery*, to which this was planned to be a companion volume.

A great amount of time and trouble has been spent on its preparation. The numerous subheadings and types have involved heavy labour for the publishers, and the great number of facts and theories included has necessitated much revision. As the result of this, and of a long interruption due to the War, the book appears several years after the original date assigned, and its publication has repeatedly been delayed, even since the return of peace: yet it is inevitable that many passages must still occur which need or would benefit from alteration, and any criticisms and suggestions will be welcomed.

Finally, I must thank the publishers—and especially Dr. A. E. Mahood and Mr. F. S. Hunter, who have read the entire proofs—for the great care they have bestowed upon the production, for their kindness in waiting for the manuscript until I was able to return to civilian practice, and for numerous suggestions and comments, which have saved many errors that otherwise would have escaped notice.

Dr. Pantón has also read certain portions of the manuscript and helped me with his advice.

H. L. T.

LONDON,

July, 1920.

Glandular Fever—Febrile Type, continued.

including occipital. May be tender or discovered on routine examination. Rare before rash subsides.

Temperature.—At onset rises again to 101° or up to 104° . Remittent for varying periods. Gradually subsides. (Total pyrexial period from onset, about two months.)

Blood.—Mononucleosis develops. Total leucocytes, 15,000 to 30,000 or more; about 70 per cent mononuclear.

Spleen.—Often becomes palpable.

Duration.—Usually about 4 weeks; may be considerably longer.

RECURRENCES AND RECRUDESCENCES.—May be several, lengthening course and pyrexia to several months, with much exhaustion. May be recurrence after long apyrexial period.

Blood Changes.—Myeloid, lymphoid, and monocytic tissues are all affected: blood-picture depends on sum of the three reactions. Myeloid tissue reacts first: polynucleosis or neutropenia in earliest stage, latter resulting in relative lymphocytosis; effect is transient and not often observed in glandular type. Lymphoid tissue reacts next, and lastly monocytic tissue: circulating blood then contains excess of lymphocytes and monocytes and primitive cells of both series, thus exhibiting numerous types of mononuclear cells, varying rapidly in numbers. Monocytes usually disappear before lymphocytes.

TOTAL LEUCOCYTES.—Commonly 10,000 to 15,000; over 20,000 unusual; over 30,000 rare; maximum 50,000 (in infants may be somewhat higher).

MONONUCLEAR CELLS.—Percentage commonly between 60 and 70, not uncommon up to 80, rare over 90. Variety of mononuclear cells present is predominating feature; there is no characteristic differential count.

RED CELLS.—Usually no change.

Heterophile Antibodies (Paul-Bunnell Reaction).—Heterophile antibodies may be described approximately for this purpose as the presence in human blood of agglutinins and hæmolysins to sheep's red cells: present in normal human serum in titre 1-8, after injections of horse serum transiently in titre up to 1-200. In glandular fever, titre commences to rise early, may be diagnostic by fourth day, rapidly attains maximum, and tends to return nearly to normal in about six weeks, may be longer. Specific for glandular fever if titre is 1-64. Recorded very rarely in other conditions, but confusion improbable.

Wassermann and Kahn Reactions.—May be positive temporarily about second week.

Eruptions.—Commonest forms are: (a) *Maculo-papular*—may closely resemble enteric; (b) *Rubelliform*—may be indistinguishable from

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Blood Pictures.—In idiopathic steatorrhœas, factors which influence blood formation may vary thus: (1) Free hydrochloric acid: may be present or absent. (2) Intrinsic gastric factor: may be present or absent. (3) Extrinsic factor: (a) Absorption affected by defective fat metabolism; (b) Affected by absence of intrinsic factor; (c) May be deficient in the diet. (4) Various combinations of the above. The resulting blood picture may be:—

1. **SIMPLE HYPOCHROMIC (MICROCYTIC) ANÆMIA.**—Responds to iron.
2. **MEGALOCYTIC HYPERCHROMIC ANÆMIA.**—Due to:—
 - a. **ABSENCE OF INTRINSIC FACTOR.**—Responds to liver or equivalent.
 - b. **DEFICIENCY OF EXTRINSIC FACTOR.** Responds to yeast.
Note.—In absence of free HCl, response to yeast is improbable, though possible.
3. **VARIOUS IRREGULAR BLOOD PICTURES.**—Due to combinations of factors. Respond to yeast or 'liver', with or followed by iron.

LEUCOCYTES.—Changes usually slight, but leucopenia common.
COURSE OF BLOOD CHANGES.—Anæmia may commence as 'simple hypochromic', advance later to 'megalocytic', and under treatment return to hypochromic and then become normal. Aplasia occurs rarely.

NOTES.—

1. Above applies to cœliac disease, sprue, various fatty diarrhœas, certain tropical anæmias.
2. For distinction from true pernicious anæmia, see **PERNICIOUS ANÆMIA—THE BLOOD.**
3. Treatment of anæmia is separate from that of diarrhœa and tetany, but anæmia improves with treatment of fat defect.

Treatment.—See **CÆLIAC DISEASE IN CHILDREN.**

XIX. SPRUE.

(*Psilosis.*)

An atrophic condition of the alimentary tract following residence in tropical climates, characterized by soreness of the tongue and mouth, fatty diarrhœa, wasting, and anæmia, with tendency to remissions and relapses.

General manifestations closely resemble cœliac disease and adult steatorrhœa, but complete identity uncertain.

Etiology.—Confined to hot climates. Never epidemic, not contagious. Mainly in Europeans: no obvious connection with diet. Usually after long residence: rarely in 1 or 2 years or less. Aided by dysentery and debilitating conditions. Onset may be delayed until several years after return to temperate climate.

No cause known. Possibly a deficiency in food absorption.

Pathology.—In later stages, atrophy of mucous membrane; in colon, small mucous cysts. Commences as acute catarrhal inflammation of alimentary tract, followed by ulceration. Small

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Pleurisy with Effusion—Course, continued.

ABSORPTION.—Earliest sign : displacement of organs diminishes. Breath-sounds and, later, tactile fremitus return. Rarely redux friction rub. Breath-sounds and percussion note at base may remain impaired : temporarily due to collapse of lung ; may become permanent from thickened pleura and adhesions ; hence difficult to certify complete absorption of fluid. With rapid absorption, chest wall falls in, and returns but slowly or incompletely, owing to adhesions.

ADHESIONS.—Occur at termination of all pleurisies : may give no physical signs, as after dry pleurisy.

3. EMPYEMA.

(*Purulent Pleurisy.*)

Etiology.—

AGE.—Commonest under 10 years. Then at 20 to 30 years, from incidence of pneumonia.

CAUSES.—

1. **ACUTE PNEUMONIA.**—Predominant cause. See p. 58.
2. **EXTENSION FROM PNEUMOCOCCAL OR SEPTIC FOCI OR SEPTICÆMIA.**—High mortality.
3. **TRAUMA.**—Fractured ribs, penetrating wounds.

Bacteriology (*see* PLEURAL FLUIDS, p. 597).—Commonly pneumococcus or streptococcus.

Morbid Anatomy.—Inflammation of pleura as in pleurisy with effusion. Exudate purulent. Opened post mortem, pleuræ usually thickened, and often thick pus at base, with clear fluid above.

Symptoms.—Characteristics are : (1) Symptoms of sepsis, viz., irregular pyrexia, malaise, sweating, chills ; (2) Signs of fluid ; (3) Purulent fluid on aspiration ; (4) Leucocytosis.

ONSET.—Insidious, in course of causal disease. In lobar pneumonia, temperature does not fall, or rises again after a few days.

IN CHILDREN.—Pallor, weakness, often vomiting and diarrhoea. Dyspnoea if much fluid : otherwise symptoms slight.

Physical Signs.—As in pleurisy with effusion. Bilateral empyema rare.

DIFFERENCES FROM SEROUS EFFUSIONS.—(1) Displacement of heart and diaphragm more marked (ascribed to weight of pus) ; (2) Intercostal space may bulge ; (3) Œdema of chest wall occasionally.

In children loud tubular breathing does not *exclude* empyema.

CLUBBING OF FINGERS.—Occasionally, in effusions of three or more weeks' duration.

LEUCOCYTOSIS.—Marked : rarely under 15,000.

Termination.—

WITH REMOVAL OF PUS.—After pneumonia prognosis good. Occasionally discharge persists owing to : (1) Lung unable to expand—e.g., after carnification or adhesions ; (2) Absence of resolution, and subsequent fibrosis of lung ; (3) Abscess of lung.

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Hæmaturia—Differential Diagnosis of Cause, *continued*.

c. DISTRIBUTION OF BLOOD DURING MICTURITION.—Patient passes water into three vessels:—

Blood equally in all: renal or severe vesical cause.

Blood mainly in first: prostatic or urethral cause.

Blood mainly in last: vesical origin.

2. PHYSICAL SIGNS.—Rectal examination for prostate. X rays. Cystoscopy. Catheterization of ureters.

3. SYMPTOMS.—

AGE.—In elderly persons: especially calculus or neoplasm. In young persons: may be tuberculosis.

DISTRIBUTION OF PAIN.—At end of penis: cause in bladder.

Renal colic: cause in kidney or ureter. (Clots of blood from any site may cause pain in penis when passed.)

Various symptoms often point to cause of the hæmorrhage, e.g., endocarditis in renal infarcts.

III. HÆMOGLOBINURIA.

See HÆMOLYTIC ANÆMIAS, p. 709.

IV. ALBUMINURIA.

Albumin may occur in urine in the absence, and without subsequent development, of the condition of nephritis.

Varieties and Causes.—(1) *Physiological*: No renal or other lesions. (2) *Organic*: (a) Renal or urinary lesions; (b) General causes.

1. PHYSIOLOGICAL ALBUMINURIA.—Age at discovery usually 15 to 30 years. Generally discovered accidentally in routine school or life insurance examinations. Hence more frequently recorded in males. May cease at puberty or persist longer. Excretion may be erratic or permanent, or may follow severe exertion, exposure to cold, or (doubtful) excessive protein diet. Numerous names, the etiology not being identical in all forms—e.g., 'cyclic', present for a few days, then absent; also functional, postural, intermittent, dietetic, paroxysmal, and orthostatic or albuminuria of adolescence or of puberty. MacLean in apparently healthy recruits found albuminuria in 5.62 per cent—viz., trace in 3 per cent, marked in 2 per cent; also casts in 2 per cent—viz., hyaline in 1 per cent, hyaline and epithelial in 1 per cent. Of this total 1 per cent represented definite disease with inefficiency of kidney, remainder being harmless physiological albuminuria.

2. ORGANIC ALBUMINURIA.—

a. RENAL OR URINARY LESIONS.—

i. *Nephritis*. *Amyloid disease*.

ii. *Passive Renal Congestion*.—From cardiac failure in diseases of the heart and lungs. Rarely from pressure on renal veins from neoplasm or thrombosis of vena cava.

iii. *Poisons*.—Arsenic, phosphorus, lead, mercury, turpentine.

iv. *Pregnancy*.

v. *Pyuria or Hæmaturia*.

B.—DISEASES OF DEFICIENCY.

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disease and syndrome (*see* p. 394) may also be associated with blood changes. (iii) *Sternberg's leukosarcoma*. In this type, mediastinal glands only or a single group elsewhere tend to be affected, but infiltration of other tissues occurs: histologically resembles lymphosarcoma. Blood shows changes of lymphoid leukæmia: may develop only after X-ray treatment.

- b. **AFFECTIONS OF MYELOID TISSUE.**—Changes in the red and myeloid cells may result from irritation of bone-marrow. *See* LEUCO-ERYTHROBLASTOSIS (p. 742).

2. **Leukanæmia** (Leube).—Conditions combining megaloblastic anæmia and features suggestive of leukæmia. Is not an entity. Occurs in various blood disorders, e.g.: (a) Leuco-erythroblastosis. (b) Myeloid leukæmia, in acute and later stages of chronic form: irritation of erythroblastic tissue by myeloid tissue. (c) Pernicious anæmia, rarely: irritation of myeloid tissue by erythroblastic tissue

3. **Aleukæmic Leukæmia.**—*Tissue changes of leukæmia with blood normal or little changed.* (Traditional definition. The older literature is confused and largely incomprehensible.) Is not an entity, and includes many types. Common point is that number of leucocytes is about normal or reduced. Features leading to diagnosis may be hæmatological or clinical, e.g.: (a) relative lymphocytosis, (b) few myelocytes, (c) splenomegaly, (d) enlarged glands. Some terminate after periods often prolonged as fully developed lymphoid or myeloid leukæmia. Others fall into group of leuco-erythroblastosis. Sternal puncture aids.

Title is frequently applied to conditions with qualitative changes of leukæmia but with leucopenia: this is not aleukæmic leukæmia as originally described, but *leucopenic* leukæmia.

4. **Mixed Leukæmias.**—Existence of a mixed myeloid and lymphoid leukæmia is unproved: so also is change of type from myeloid to lymphoid or vice versa. Recorded cases may be ascribed to: (a) Confusion between myeloblasts and lymphocytes; (b) Infiltration and irritation of myeloid tissue with lymphocytes in lymphoid leukæmia as in other forms of leuco-erythroblastosis (*see* p. 742); (c) Neutropenia in myeloid leukæmia leaving lymphocytes as predominant cells. Some evidence exists for mixed monocytic and myeloid leukæmia.

5. **Eosinophilic Leukæmia** (splenomegaly with eosinophilia).—A few recorded cases with splenomegaly, leucocytosis (20,000 to 200,000), and high percentage of eosinophils, 70 to 90 per cent; few myelocytes only. Glands may be enlarged. Eosinophils numerous in all hæmopoietic tissue. Course usually chronic: rarely acute with hæmorrhages. Splenectomy, no effect. Various neoplasms inexplicably present in some cases. (*See also* EOSINOPHILIA.)

NEUTROPHILIC AND BASOPHILIC LEUKÆMIA.—A few cases with other normal cells predominant, e.g., neutrophils 90 per cent, basophils 80 per cent. Relation of these cases to leukæmia undecided.

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PERCUSSION.—*Dullness* over sac: anteriorly, or posteriorly to left of spine. May be present without pulsation.

AUSCULTATION.—(a) Over aneurysm: (i) *Loud second sound*, or diastolic murmur: (ii) 'Systolic' murmur. (b) At aortic area: Loud second sound or diastolic murmur.

X RAYS.—Frequently diagnostic: expansile tumour in line of aorta.

Notes on above Physical Signs.—

Pulsation.—Position: Near main line of aorta; anteriorly, to right of sternum or in suprasternal notch; posteriorly, to left of spine (almost always aneurysm, adherent pericardium producing 'tug' only). Pulsation anteriorly may be: (a) Diffuse: also in anæmia, neurasthenia, etc., and in tumours. (b) Expansile. If definitely *expansile* is almost pathognomonic, but clot in sac may prevent it; expansile sarcoma very rare in thorax. Large external tumour may be present.

Diastolic Shock over Sac.—Not common; characteristic if present. Caused by large volume recoiling on aortic valves. Hence: (a) Only in ascending arch; (b) Associated with loud second sound over sac and loud aortic second. With aortic incompetence, all three signs are replaced by diastolic murmur.

Aortic Second Sound is most important auscultatory sign: if *normal*, strongly against aneurysm of *ascending* arch.

Systolic Thrill.—Slight or intense; absent if much clot.

Associated with systolic murmur. (Occurs at expansion of sac, and thus not strictly 'systolic' in time.)

Systolic murmur alone is of little importance.

2. **PRESSURE SIGNS.**—Especially in aneurysms of transverse arch. (a) Pressure on veins. (b) Pressure on arteries: Inequalities of pulse and of blood-pressure. (c) Inequalities of pupils. (d) Pressure on air tubes and lungs: (i) Bronchitis, collapse, etc.; (ii) Tracheal tugging; (iii) Displacement of trachea (uncommon). (e) Pressure on recurrent laryngeal nerve.

a. **PRESSURE ON VEINS**—**CEDEMA AND DILATED SUPERFICIAL VEINS.**—*Less common than with glandular or malignant tumours.* May be: (i) Innominate vein, left more common; (ii) Superior vena cava. Signs limited to area drained. Rarely *clubbing of fingers*. Rupture common into affected vein.

b. **PRESSURE ON ARTERIES**—**INEQUALITIES OF PULSES.**—Pulses on the two sides (e.g., *radial*) may be: (i) Asynchronous; (ii) Unequal in force. Alterations due to: (a) Pressure of sac on arteries; (β) Reservoir action of sac retarding and also flattening pulse-wave.

Typical effects.—High ascending arch: Sac presses on right subclavian artery; right radial pulse small and flat, but synchronous. Transverse arch: Pulses asynchronous, left flattened. Descending arch: Pressure on left subclavian artery; left radial pulse small and flat, but synchronous. Descending aorta: Radials normal;

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DISEASES OF THE SUPRARENAL BODIES.

I. HISTOLOGY AND FUNCTIONS OF THE SUPRARENAL BODIES.

General Description.—The suprarenal bodies are 'endocrine organs', ductless glands with an internal secretion. Are in anatomical but no other relation to kidneys; do not move with a *rena mobilis*. Average weight 5 to 7 gm. Consist of a fibrous capsule, and within this two layers, (1) cortex, (2) medullas entirely distinct in origin and function, though with same blood-supply.

CORTEX.—Yellow colour, with browner band next to medulla.

Mesodermic origin. Connective tissue passes in from capsule.

Histology: Roundish cells arranged in strands. Three layers recognizable: (a) Zona glomerulosa. (b) Zona fasciculata: definite columns; many lipid granules. (c) Zona reticularis: junction of columns; cells pigmented. *Note.*—The lipid is yellow cholesterol ester; distribution varies.

MEDULLA.—Soft and dark red. Ectodermic origin. Consists of: (a) Anastomosing strands of cells enclosing blood-spaces; stain brown with chromic acid, hence called '*chromaffin cells*'. (b) Nerve-cells like sympathetic ganglion cells; single or in small groups. (c) Non-medullated nerve-fibres. Blood-vessels very numerous. Nerve-supply rich, chiefly from solar and renal sympathetic plexuses, and some fibres from vagus.

'Chromaffin Tissue or Cells' in other Sites.—Kohn's '*paraganglia*' or '*chromaffin bodies*' are small masses, not exceeding a pea in size, along the aorta; chiefly the abdominal aorta and near kidneys—e.g., '*Zuckerlandl's organ*' near origin of superior mesenteric artery. Structure roughly resembles suprarenal medulla; many cells chromaffin: probably same function. Kohn also included: (1) Carotid glands, at bifurcation of common carotid: contain chromaffin cells. (2) Coccygeal glands: probably sympathetic origin, but chromaffin cells doubtful.

Accessory Suprarenal Bodies. Suprarenal 'Rests'.—Consist of cortical substance. Common in the liver and other structures—e.g., '*Marchand's organ*' in broad ligament near ovary (almost constant). Rarely with both cortex and medulla, occasionally in solar plexus.

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SYNOPSIS OF MEDICINE

Section I.—SPECIFIC INFECTIOUS DISEASES.

A. BACTERIAL DISEASES.

CHAPTER V.

TYPHOID FEVER.

An acute disease due to infection by *B. typhosus*, characterized clinically in typical instances by: (1) Fever; (2) Rose-coloured eruption; (3) Enlarged spleen; (4) Abdominal tenderness; (5) Diarrhoea or constipation.

The symptoms and degree of severity are very variable. Marked localization may occur, especially in lungs and central nervous system.

ETIOLOGY.

General Prevalence.—Typhoid fever exists throughout the world, without notable differences. Prevalence is falling rapidly. *Death-rate* in England and Wales in 1910, 46, and in 1931, 6 per million persons. Is greater in other countries.

Season.—Most prevalent in autumn: probably due to effect of temperature on existence of organisms outside the body.

Sex.—Males and females equally liable. In hospitals more frequently seen in males.

Age.—Most frequent in youth and early adult life, between ages of 10 and 30. At extremes of life, course tends to be atypical. Infants rarely attacked. Is never congenital. Very rare over 50 years of age.

Immunity.—One attack usually protects.

BACTERIOLOGY.

Morphology.—Short, thick, actively motile bacillus with rounded ends. Involution forms, often of great length, common, especially in old cultures. No spores. Flagella, 8 to 12 in number: need special stains. Stains with all ordinary stains, but is *Gram-negative*. These characteristics are common to the coli-typhoid group.

Growth optimum at 37° C. Cultures killed at 60° C. in thirty minutes. Resistant to drying.

* Typhoid fever is here described as it occurs in uninoculated persons. The variations in inoculated individuals and in paratyphoid infections are referred to at the end of the chapter.

The term 'typhoid' is now sometimes confined to infections with *B. typhosus*, 'enteric' including also paratyphoid infections. This is often convenient, but the terms are still in general use as synonyms.

Typhoid—Bacteriology, continued.

Cultural Characters.—Grows readily on all usual media. On solid media growth usually appears moist. No gas produced in any carbohydrate media. Special characters: (1) Lactose, dulcitol, saccharose: no change. (2) Dextrose, mannite, maltose: acid, but no gas. (3) Litmus milk: acid, but no clot (after ten days often returns to alkaline). (4) No indole formation. (5) Gelatin: no liquefaction. (6) Neutral-red broth: no change, or slightly yellow. (7) MacConkey's medium: yellow colonies.

Selective Media.—Numerous media have been devised for the growth and isolation of *B. typhosus*. These media depend mainly on reactions of various dyes. Their value results from: (1) Differentiation of *coli* and *typhosus* colonies; (2) Inhibition of *coli* group and enhancement of *B. typhosus*. Most commonly used are: MacConkey's medium—neutral-red bile-salt peptone lactose agar ('rebipel-agar'). Conradi-Drigalski—crystal-violet, nutrose, lactose, and other constituents. Fawcett's brilliant-green and picric-acid medium. Browning's brilliant-green method—peptone-water (5 c.c.) containing 0.5 c.c. of 1-10,000 solution of brilliant-green; method is based on inhibitory action on the *coli* group. Ox-bile: typhoid group grows very readily.

Differentiation of Coli Group.—*B. coli communis*: (1) Produces red colonies on MacConkey's medium; (2) Produces acid and gas in lactose and most carbohydrates; (3) Acidifies and clots milks. Also other differences. *B. proteus* produces yellow colonies on MacConkey, but liquefies gelatin.

'NON-LACTOSE FERMENTERS'.—The pathogenic bacilli, typhoid, paratyphoid, dysentery, do not ferment lactose. *B. coli* and most of the non-pathogenic bacilli ferment lactose, but some only slowly ('late lactose-fermenters'), and certain common strains of the *coli* group do not at all, and must be differentiated by (1) agglutination, and (2) other cultural characteristics.

MACCONKEY'S MEDIUM.—'Non-lactose fermenters' form yellow or colourless colonies; *B. coli* and lactose fermenters form red colonies.

Methods of Isolation.—These are equally applicable to paratyphoid bacilli, but brilliant-green is strongly bactericidal to dysentery bacilli.

1. FROM THE BLOOD.—Cultures into broth or ox-bile. Incubated one to five days. Identification of any growth.
2. FROM STOOLS OR URINE.—Cultures into broth (incubate two hours) or Browning's brilliant-green peptone water (incubate twenty-four hours). Plate on MacConkey's medium.
3. FROM THE SPLEEN.—Best method at autopsy. Remove spleen entire. Cut with sterile knife. Cultures into broth or brilliant-green. Plate on MacConkey's medium.

Numerous variations of the above methods are in extensive use.

Distribution of Bacilli in the Body.—

1. ACUTE STAGES.—(1) *In blood*: present for first 5 days, and rarely to 10 days. (2) *Peyer's patches* and intestinal lymphoid

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tissue : after first few days until ulceration occurs ; may then be present deeper in wall. (3) *Spleen* : most numerous and easily isolated, but also present in kidney and other solid organs. (4) *Gall-bladder* : often in large numbers. (5) *Fæces* : probably invariably present after first few days. (6) *Urine* : present in small proportion in later stages.

2. **CHRONIC FORMS** (*see also below, CARRIERS*).—(1) *Gall-stones*. (2) *Pus and typhoid abscesses*. (3) *Excreta of 'carriers'*, usually fæces. The gall-bladder is the main reservoir for chronic forms. The bacillus has been isolated from numerous sites—from lungs in pneumonia, from endocarditis, from rose-spots (rarely), etc.

Survival of Bacillus outside the Body.—

IN WATER.—In sterile water cultures of bacilli live many weeks. In natural waters uncultured bacilli, from excreta, die in less than two weeks. In aerated water, bacillus lives not more than two weeks. Infection has resulted from ice.

IN MILK.—Lives and multiplies without changing the milk's appearance.

IN SOIL.—Can live several months. Probably does not multiply.

IN STOOLS AND SEWAGE.—Dies in three to five days.

ON CLOTHES AND MATERIALS.—May live many months.

B. typhosus fulfils Koch's postulates : (1) Is constantly present in the disease ; (2) Can be isolated and cultivated outside the body in successive generations ; (3) The isolated organism reproduces the disease.

MODES OF CONVEYANCE OF INFECTION.

The bacilli are discharged in the excreta, which directly or indirectly are the cause of spread.

1. **Contagion.**—Local propagation, mainly by fingers, food, and flies. Direct transmission through the air is extremely improbable.
2. **Infection of Water.**—Contamination of water-supply is usual cause of large epidemics. Often due to defective sanitation.
3. **Typhoid Carriers.**—Bacilli may persist for years in the body without symptoms after typhoid fever. Found in *gall-bladder* and *gall-stones*, fæces, intestines, and bone abscesses after 20 years and upwards. No limit to length of time. Numerous outbreaks have been traced to typhoid carriers, especially to cooks, bakers, and dairy employees.

Women form three-fourths of carriers (in peace).

Serum usually gives marked agglutination reaction, but not invariably.

Stools frequently contain numerous typhoid bacilli.

Bacilli may be present in stools of persons who have had no symptoms of typhoid fever. Especially true in children.

4. **Infection of Food.**—Outbreaks have been traced to several articles : *Milk*—contamination by infected water, or typhoid carrier ; *Ice, vegetables, salads* ; *Oysters*—certain outbreaks, e.g., Winchester. *Any article handled by a typhoid carrier may convey the bacillus.* (*See also* FOOD POISONING.)

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Typhoid—Modes of Conveyance of Infection, *continued*.

5. **Flies**.—Power to carry bacillus is certain. In South African War, constituted an active agent in spread.
6. **Contamination of the Soil**.—*Bad sewers or cesspools* are predisposing causes, and may lead to infection of water-supply. *Dust* may carry bacilli. Bacilli when desiccated die rapidly.

MORBID ANATOMY.

Intestines.—The changes characteristic of typhoid occur in the lymphoid tissue of the intestines, mainly in Peyer's patches, *especially in the last foot of the ileum*. Also in solitary follicles. Condition is a proliferative inflammation followed by necrosis. Four stages: (1) *Hyperplasia*; (2) *Necrosis and formation of sloughs*; (3) *Ulceration*; (4) *Healing and cicatrization*.

1. **HYPERPLASIA**.—Swelling of Peyer's patches and the solitary follicles.

Commences with hyperæmia, followed by hyperplasia, viz., increase of lymphoid and epithelioid cells. Follicles and patches project above the surface. Blood-vessels compressed, hence projections are often greyish. Condition at maximum from eighth to tenth day.

Necrosis is usual result. *Resolution* may occur in mild cases, by degeneration of cells and absorption without ulceration. Similar hyperplasia is seen in children with intestinal affections, also occasionally in measles, diphtheria, and scarlet fever. In adults, very rare apart from typhoid fever.

2. **NECROSIS AND FORMATION OF SLOUGHS**.—Necrosis of swollen lymphoid elements, resulting in formation of sloughs. *Depth of necrosis* varies. In solitary follicles superficial. Deepest in patches near ileocæcal valve. Usually involves submucosa; may perforate peritoneum. Reticulated appearance of a Peyer's patch frequently caused by independent necrosis of several follicles. The necrosis may be the result of the action of toxins produced by the bacilli, or due to blockage of blood-vessels.

3. **ULCERATION**.—Separation of sloughs. Sloughing commences at edge of necrotic area. Extent and depth depend on necrosis. Uncommon to affect entire Peyer's patch.

TYPHOID ULCER results from separation of slough.

Characters.—*Long axis* in line of intestine. *Shape*: usually irregular oval. *Edges*: soft, undermined, swollen, not indurated. *Floor*: smooth; usually formed of muscularis. *Peritoneal surface*: changes slight.

Patches often in various stages in different parts of intestine.

Ulcers most frequent and numerous in last twelve inches of ileum.

4. **HEALING AND CICATRIZATION**.—Granulation tissue forms and covers floor. Epithelium then extends inwards from edge of mucosa. Glands may re-form partly.

Healed ulcer is smooth, slightly depressed, and pigmented.

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Finally, practically no sign of scar remains.

Stricture never follows, and intestinal obstruction never results.

Majority of deaths occur before cicatrization commences.

Typhoid bacilli are present in tissues in early stages, but diminish or disappear during necrosis.

LARGE INTESTINE.—Lymphoid elements affected in one-third of cases. Severity diminishes with distance from ileocaecal valve. Occasionally is extensively affected, and then often severe in sigmoid and rectum, with marked changes in ileum.

PERFORATION OF THE BOWEL (*see p. 13.*)

HÆMORRHAGE FROM THE BOWEL.—Results from separation of the slough. Blood present in intestine.

Mesenteric Glands.—Hyperæmia and, later, hyperplasia and swelling occur as in intestinal lymphoid tissue. Necrosis and absorption follow. Foci of necrosis common. Glands in mesentery at lower end of ileum especially involved. Suppuration very rare. Rupture of gland extremely rare: may cause peritonitis or fatal hæmorrhage.

Spleen.—Enlarged invariably in early stages. *Increase moderate.* Weight over $1\frac{1}{2}$ lb. uncommon. Soft consistency. Changes similar to glands: hyperæmia and, later, hyperplasia, returning to normal about fourth week. Rupture very rare. Infarcts not common. Typhoid bacilli scattered throughout, often in clumps.

Bone-marrow.—Changes very similar to those in lymphoid elements.

Liver.—Hyperæmic. Swollen in early stages only. Some parenchymatous and fatty degeneration of liver cells. Foci of leucocytes and sometimes of lymphoid cells not uncommon. Typhoid bacilli frequently present. Liver abscess extremely rare.

Gall-bladder.—Cholecystitis may occur, but rare. (*See also CARRIERS, p. 3.*)

Kidneys.—Cloudy swelling usual. Acute nephritis occasional. Rarely miliary abscesses. *B. typhosus* and *B. coli* may be present. CYSTITIS occasionally occurs: due to *B. typhosus* or, more commonly, *B. coli*.

Respiratory System.—

LUNGS.—*Bronchitis practically invariable in early stages.* Following also occur: (1) *Lobar pneumonia*, early or late in the disease: in 5 per cent of fatal cases. (2) *Hypostatic congestion* and splenization: late stages in feeble patients. (3) *Hæmorrhagic infarction*. (4) *Fibrinous pleurisy*: empyema rare. (5) *Gangrene and abscess of lung*: occasional termination of pneumonia.

FAUCES.—Ulceration of larynx due to presence of typhoid bacilli occurs rarely. Occasionally: œdema of glottis; diphtheroid conditions of pharynx and larynx.

Circulatory System.—

HEART.—Endocarditis and pericarditis rare. Ulcerative endocarditis usually due to pyogenic organisms, but typhoid bacilli have been isolated. *Myocarditis* not infrequent: muscle soft, pale, and flabby. Fatty and granular degeneration common. Zenker's hyaline degeneration rare.

Typhoid—Morbid Anatomy—Circulatory System, continued.

BLOOD-VESSELS.—Thrombosis of veins, especially left femoral, not uncommon complication. Changes in the arteries are slight.

Nervous System.—Organic changes rare. Meningitis extremely rare.

Voluntary Muscles.—Zenker's hyaline degeneration may occur. Condition not confined to typhoid fever, but very rare in other febrile states. Affected muscles may rupture. Abdominal muscles, adductors of thigh, and pectorals most common.

SYMPTOMS.

A general description of the symptoms is given here. In the next section are considered the modes of onset, and the special features and symptoms, complications, and sequelæ, according to the various systems.

An ordinary attack of typhoid fever is generally described as consisting of: period of incubation; period of onset; the febrile period, divided into, and referred to as, the first, second, third week, etc. (usually three weeks); and convalescence. The changes in the symptoms, and the complications and sequelæ, often agree with these periods very closely; but they must not be considered as hard-and-fast divisions.

Period of Incubation.—Commonly 10 to 15 days. Ordinary limits 5 to 23 days. Extreme limits 3 days (culture swallowed) to 4 weeks and upwards.

Symptoms of lassitude commence, and period merges into next stage.

Period of Onset.—*Onset is insidious.* Very rarely abrupt.

INITIAL SYMPTOMS.—(1) *Headache*: most common symptom, persistent and severe. (2) *Weakness and languor.* (3) *Abdominal pain.* (4) *Diarrhœa or constipation.* (5) *Anorexia.* (6) *Epistaxis.* (7) *Chilly sensations (definite rigors uncommon).* All these are common.

Symptoms become more severe. Patient takes to bed. Date of onset and division into weeks is usually reckoned from day of taking to bed, or estimated from temperature chart.

First Week.—(1) *Appearance*: Cheeks flushed; eyes bright; tongue furred. Slight deafness common. (2) *Headache* rarely absent. May be slight mental confusion. (3) *Bronchitis* almost invariable; crepitations at both bases; cough usually slight. (4) *Abdomen* tender and slightly distended. (5) *Bowels*: Diarrhœa or constipation. (6) *Temperature* rises steadily by 'steps'. On evening of fourth day reaches 103°. (7) *Pulse*: (a) *Rate slow compared with temperature—in adults rarely exceeds 105*; (b) *Low tension—more commonly dicrotic than in any other fever.* (8) *Between seventh and tenth day, three important events occur*: (a) *Spleen* becomes palpable; (b) *Rash* appears; (c) *Agglutination reaction* becomes positive.

Second Week.—Mental torpor. No headache. Expression dull. Pale face, with occasional flush, dilated pupils, and dry lips form characteristic appearance. Deafness often marked. *Temperature*

remains constantly high. *Pulse* may remain slow: usually becomes more rapid; no longer dicrotic. *Tongue* dry. *Abdominal symptoms* increase. Constipation obstinate. If diarrhoea, stools resemble 'pea-soup'. Delirium in severe cases, especially at night. Death may occur with pronounced nervous symptoms. Haemorrhage and perforation may occur towards end of week.

Third Week.—*Period of dangerous complications.* In ordinary cases, general symptoms remain as in second week. *Loss of flesh and weakness* now marked. *Temperature* becomes irregular, with morning remissions, and commences to decline. *Pulse* 110 to 130.

UNFAVOURABLE SYMPTOMS—(1) *Mental symptoms* pronounced: 'typhoid state' or delirium. (2) *Temperature* remains high or rises. (3) *Cardiac weakness*: pulse very rapid or irregular. (4) *Pulmonary complications*: pneumonia, hypostatic congestion. (5) *Extreme weakness.*

SPECIAL DANGERS, due to separation of sloughs.—(1) Haemorrhage. (2) Perforation.

In mild cases, symptoms subside.

Fourth Week.—

IN ORDINARY CASES.—Convalescence commences: *Appetite* returns: often ravenous. *Temperature* gradually becomes normal. *Tongue* cleans. *Mental and abdominal symptoms* subside. General condition is extremely weak.

IN SEVERE CASES.—General aggravation of symptoms. 'Typhoid state' may occur: Face cyanosed; clammy perspiration; dry fissured tongue; sordes of lips; delirium, muttering or frequently restless, or 'coma vigil'; incontinence of urine and faeces; lungs congested; rapid, feeble pulse, often irregular.

SPECIAL DANGERS.—Failure of heart. Secondary complications.

Fifth and Sixth Weeks.—In ordinary cases, general progress. In protracted cases, convalescence commences. *Relapses, recrudescences, complications, and sequela* may occur.

SPECIAL FEATURES AND SYMPTOMS.

Modes of Onset.—Onset usually insidious. *Localization of symptoms* to one system not uncommon at onset: extremely deceptive, and diagnosis difficult; onset may be acute in these types.

The variations from the normal onset may be grouped thus:—

1. **WITH PULMONARY SYMPTOMS.**—Clinical types: (a) *Lobar pneumonia*: pneumo-typhoid: commonest form of localization. (b) *Acute pleurisy*: pleuro-typhoid. (c) *Bronchitis*: exaggeration of common initial bronchitis.

2. **WITH NERVOUS SYMPTOMS.**—Clinical types: (a) *Headache* of exceptional severity. (b) *Facial neuralgia*. (c) *Delirium*, especially in ambulatory forms. (d) *Mania* and mental symptoms. (e) *Symptoms of cerebrospinal meningitis*, rare, mostly in children, occasionally simulating basal meningitis.

3. **WITH GASTRO-INTESTINAL SYMPTOMS.**—Clinical types: (a) *Acute gastritis*. Incessant vomiting. (b) *Appendicitis*. May be closely simulated. (c) *Diarrhoea*.

Typhoid—Modes of Onset, continued.

4. WITH ACUTE NEPHRITIS.

5. AMBULATORY OR LATENT FORMS.—Patient may 'fight the disease' and remain at work until symptoms and signs of the 'second week' are present. Subsequent course often very severe. Delirium common. Mortality high. Rarely, *perforation* or *hemorrhage* from the bowels is first symptom.

Facial Aspect.—In first week, eyes bright and cheeks flushed. Later, with mental torpor, the eyes become dull.

Fever.—

1. TYPICAL COURSE.—

STAGE OF ONSET AND FIRST WEEK.—Temperature rises by 'steps', the evening rise being about 2° , and the morning fall about 1° . Approaches 104° on evening of fourth day.

Fastigium (maximum) at end of week: usually about 104° .

SECOND WEEK.—Temperature steady. Daily variations slight.

THIRD WEEK.—Temperature becomes remittent, and falls by 'steps'. The morning temperature shows increasing falls for two or three days, while the evening rises to its previous height. Then the evening temperature also falls progressively. Evening temperature reaches normal in fourth week: morning temperature a few days previously.

2. VARIATIONS DURING ACUTE STAGES.—

a. TEMPERATURE OFTEN HIGH WHEN FIRST OBSERVED: 'steps' in rise having occurred previously.

b. RAPID RISE to 103° – 104° may occur with rare initial rigor, or with lobar pneumonia or localization of symptoms.

c. SUDDEN FALL important. Occurs with: (i) *Intestinal hemorrhage*: rapid anæmia, collapse. (ii) *Perforation*: rises again as peritonitis develops, pulse rapid. Rapid but not sudden fall, occasionally with severe nervous symptoms.

d. IN MILD CASES, temperature may fall rapidly in second week, or be abbreviated or modified to all degrees.

e. IN SEVERE CASES, febrile period may persist for many weeks.

f. RISE DURING COURSE may occur with: (i) Increasing severity; (ii) Lobar pneumonia or other complications. Hyperpyrexia, above 106° , of serious prognosis.

ASPIRIN usually causes sudden fall followed by rapid rise.

3. POST-TYPHOID VARIATIONS.—

a. RELAPSES AND RECRUDESCENCES (see RELAPSES, p. 20).

b. PERSISTENT FEVER DURING CONVALESCENCE.—Evening rise may persist several weeks in weak patients. In absence of symptoms, and of bacilli from excreta, may finally be disregarded.

c. PERSISTENT HYPOTHERMIA DURING CONVALESCENCE.—In weak patients. Is of no significance. Subnormal morning temperatures common.

Rigors.—Not common. In general, a rigor suggests a complication, and repeated rigors an error of diagnosis. Occurrence:—

1. AT ONSET.—Rare. Repeated rigors, very rare.

2. AT INTERVALS throughout the febrile stage. Rare. May be sweating ('sudoral form'), and simulate malaria. Occasionally severe rigors in later stages, ascribed to slight sepsis.
3. AT ONSET OF COMPLICATIONS.—Pneumonia, pleurisy, and venous thrombosis; occasionally with perforation or hæmorrhage.
4. WITH ANTIPYRETIC DRUGS.
5. OCCASIONALLY AFTER BATHS AND SPONGING.

Rash.—

TIME OF APPEARANCE.—Seventh to tenth day.

FREQUENCY.—About 70 per cent of cases. Less frequent in children.

SITE.—Abdomen and chest commonest, then back and thighs. Face, hands, and feet very rare.

CHARACTERS.—Rose-red, slightly raised, flattened papules. Disappear entirely on pressure, and reappear rapidly on release.

SIZE.—2 to 4 mm.

NUMBER.—Usually scanty and widely scattered. Frequently less than a dozen. Appear in successive crops, persist about three days, then fade, leaving slight brownish stain. Number of spots bears no relation to severity of attack.

VARIATIONS IN THE RASH.—

Occasionally very profuse.

Rarely, appears first in a relapse, or after subsidence of fever. Purpuric spots may occur. Very rarely a true hæmorrhagic typhoid fever.

Spots occasionally vesicular.

OTHER ERUPTIONS.—

MACULÆ CERULÆ or PELIOMATA.—Occur with rash. Slate-coloured spots, about twice the size of rash. Always scanty; usually on thighs, abdomen, or chest. Are caused by lice: ascribed to pigment in the salivary glands of the louse: occur, though rarely, in other febrile conditions.

SUDAMINA and MILIARIA.—Not infrequent with sweats.

ERYTHEMA.—Occasionally in first week. May occur independently of drugs.

HERPES.—Very rare.

Skin—Various Lesions.—

ODOUR.—Of 'abdominal' character in severe cases.

SWEATS.—Skin usually dry. Sweats may follow cold baths, and occur with venous thrombosis, hæmorrhage, or perforation. Occasionally repeated sweats and rigors throughout course.

BEDSORES.—In severe cases tend to form rapidly.

ŒDEMA.—May result from: (1) Venous thrombosis; (2) Anæmia and weakness—bilateral; (3) Nephritis—very rare.

NOMA and GANGRENE OF SKIN.—Very rare.

BOILS.—Not uncommon, but usually in convalescence. Frequent after cold baths. Obstinate, but rarely dangerous. Due to streptococcus or staphylococcus, not to *B. typhosus*.

HAIR.—Often falls out during convalescence of severe cases;

Typhoid—Skin Lesions, continued.

usually avoided if hair cut short in early stages. Grows again as before. Permanent baldness very rare.

LINEÆ ATROPHICÆ.—May resemble results of pregnancy.

Blood Changes.—Changes in leucocytes of diagnostic importance.

LEUCOCYTES.—(1) *Leucopenia* throughout course. Frequently under 4000. (2) *Lymphocytes relatively increased*. *Polynuclear leucocytosis* occurs with peritonitis or septic complications.

ERYTHROCYTES AND HÆMOGLOBIN.—Progressive secondary anæmia. Rarely severe until third week.

Changes persist into convalescence, and gradually disappear.

Circulatory System.—The most important phenomena are:—

FOR DIAGNOSIS.—(1) Pulse-rate relatively slow and often dicrotic in first week; (2) Blood-pressure low and tends to fall. Also leucopenia with relative lymphocytosis.

FOR PROGNOSIS.—Rapidity and irregularity of pulse.

COMPLICATIONS.—Venous thrombosis. Cardiac weakness.

SEQUELA.—Disordered action of the heart.

THE PULSE.—

FIRST WEEK.—(1) *Rate*: In adults, rarely exceeds 105, even with high fever. Usually 85 to 95. This relatively slow pulse is very constant and of importance in diagnosis. In children more rapid. In severe cases with high temperature, may be rapid throughout: prognosis serious. (2) *Character*: Dicrotic pulse common.

SUBSEQUENT WEEKS.—Frequently more rapid, 110 to 130, and smaller, but may remain slow throughout. *Not dicrotic*.

CONVALESCENCE.—Bradycardia common, about 50. May be extreme, but is of no importance. Rarely tachycardia.

THE HEART.—

HEART SOUNDS usually normal. Cardiac dullness not increased. **MYOCARDITIS** in severe cases: feeble first sound, and soft systolic murmur audible at apex and pulmonary area. In grave conditions, irregularity, etc., occur, as in cardiac exhaustion: of serious prognosis.

ENDOCARDITIS and **PERICARDITIS** rare. Latter mainly in children or with pneumonia.

DURING CONVALESCENCE.—Any form of **DISTURBANCE OF THE CARDIAC CONTRACTIONS** (q.v.) may occur, especially after severe attacks, or with predisposing causes. Rare.

BLOOD-PRESSURE.—Characteristically low. Systolic pressure in earliest stage 110 to 125 mm. Hg. Falls in second week to 90 to 100 mm., remaining low until convalescence. With hæmorrhage may be rapid fall. Rises with perforation.

THROMBOSIS OF VEINS.—One of the common complications.

FREQUENCY.—In 2 to 3 per cent.

TIME.—During third week or later. Not uncommon when temperature normal: may follow a slight exertion.

SITE.—Lower extremity with few exceptions. Left femoral vein forms 50 per cent of cases. Probably predisposed to by pressure of right iliac artery.

SYMPTOMS.—(1) Rise of temperature. Rigor common: may be sweating. (2) Sudden pain at and near site. May be partial degree of collapse, suggesting perforation. (3) Thrombus usually palpable (examine gently). (4) Swelling of extremity follows. (5) Leucocytosis usually present.

PROGNOSIS.—Good. Death from pulmonary embolism very rare, with proper treatment. Tendency to slight œdema prolonged, and varices frequent. Gangrene very rare.

PULMONARY EMBOLISM from small emboli probably not very rare: dyspnoea, pain, and slight signs in lungs.

CAUSE uncertain. Coagulability of blood may be increased.

THROMBOSIS OF ARTERIES.—Very rare. Extremity becomes blue and pulseless. Recovery usual. Gangrene rare.

Digestive System.—

APPETITE.—Lost early. Returns with convalescence, and becomes ravenous.

THIRST.—Constant. Must be gratified.

TONGUE.—Furred. At onset, thin moist fur, which gradually thickens. In ordinary cases dry in second week. In mild cases, moist throughout. Cleans in fourth week or in convalescence. Saliva diminished. *In severe cases:* (1) Tongue dry, with brown fur; (2) *Sordes* on teeth and lips. Mouth must be kept clean.

PAROTITIS.—Rare, but mortality high. Frequency 1 per cent. Chiefly in third week of very severe cases. Very rare when mouth properly treated. Usually unilateral. Generally suppurates; may be extensive sloughing. Origin: probably extension of inflammation along Steno's duct.

CANCERUM ORIS.—Very rare. Only in children. Is painless, and commences on mucous surface. Recovery exceptional.

PHARYNX.—May be congested. Membranous pharyngitis: rare, only in cases otherwise serious. Typhoid ulceration not known.

ŒSOPHAGUS.—True typhoid ulceration may occur: very rare. Dysphagia. Stricture may follow.

GASTRIC SYMPTOMS.—Slight. Nausea and vomiting rare. Occasionally severe and obstinate at onset. After first week vomiting extremely rare, and suggests complications—e.g., peritonitis, nephritis. Hæmatemesis very rare: of septic origin.

Abdominal Symptoms.—

GROUPS.—(1) Pain and tenderness; (2) Distension and meteorism; (3) Diarrhœa; (4) Constipation; (5) Spleen; (6) Hæmorrhage; (7) Perforation of ulcer; (8) Liver.

PHENOMENA OF MOST IMPORTANCE.—

FOR DIAGNOSIS.—Abdominal tenderness; palpable spleen; diarrhœa and 'pea-soup' stools.

COMPLICATIONS.—Hæmorrhage; perforation of ulcer.

FOR PROGNOSIS.—Severe diarrhœa; marked distension; and above complications.

SEQUELÆ.—Gall-stones; 'typhoid carriers'.

Typhoid—Abdominal Symptoms, continued.

1. ABDOMINAL PAIN AND TENDERNESS.—

TENDERNESS AT ONSET usually present. Pain rarely severe.

Diffuse, umbilical, or in right iliac fossa.

PAIN DURING COURSE less common. Constantly with peritonitis, rarely with hæmorrhage, occasionally with diarrhœa or constipation, or with pleurisy, thrombosis, or distended bladder. Cause frequently indefinite.

2. ABDOMINAL DISTENSION.—*Meteorism or Tympanites*: Due to loss of tone of muscular coats of intestine or stomach. Moderate degree common, and of little importance: on palpation feels doughy. *If severe*, prognosis bad: distension impedes heart and lungs and favours perforation: occurs also in peritonitis. Gurgling in cæcum very common: of little importance.

3. DIARRHŒA.—*Note*: Diarrhœa with 'pea-soup' stools is a characteristic symptom, but occurs in less than 50 per cent of cases, and with modern avoidance of purgatives is considerably less common. Profuse diarrhœa is most common in severe cases.

TIME OF ONSET AND DURATION.—Present from beginning, and persists throughout in about one-third of cases. May develop in second week. May alternate with constipation.

CAUSE.—Catarrh of gut, especially of large intestine. No relation between diarrhœa and extent of ulceration.

NUMBER OF STOOLS.—Varies: three to ten daily.

CHARACTER OF STOOLS.—Thin, large quantity. At first of normal colour; after a few days comparable with 'pea-soup'. Reaction alkaline. Odour offensive, especially in children. On standing, separation into two layers, fluid above, semi-solid below. *Mucus scanty*. Shreds from sloughs are very rarely recognizable. Defæcation painless. Typhoid bacilli rarely present before end of first week. Milk curds, a sign of defective digestion, must be watched for. (Stools of closely similar nature occasionally occur in children apart from typhoid fever.)

4. CONSTIPATION.—As frequent as diarrhœa, or more so. May occur with advanced ulceration. (Mortality in general is lower in cases with constipation than with diarrhœa.)

5. SPLEEN.—Becomes palpable at beginning of second week in 70 per cent of cases. Especially in children. In elderly patients not so constant. Gradually subsides during third week. Palpable area small: often only tip. Recognition of enlargement by percussion alone is uncertain.

6. HÆMORRHAGE.—Serious and important complication.

FREQUENCY.—In 6 to 7 per cent of cases. Incidence increases with age, rarer in children.

TIME OF OCCURRENCE.—*Between end of second and beginning of fourth week*, the time of separation of sloughs. In 'ambulatory' type, may be first definite symptom. (*Note*: Slight hæmorrhage from congestion may occur in first week; unimportant except for diagnosis.)

SYMPTOMS.—Slight hæmorrhage may occur without symptoms, except melæna: important, as severe hæmorrhage often follows. In severe hæmorrhage, symptoms are:—

- a. *Sudden onset*: without warning.
- b. *Sensation of faintness*, followed by pallor and symptoms of collapse. Restlessness, sighing respiration, cold sweat, vomiting, and, with large hæmorrhage, rapid anæmia. *Pain variable*, absent or severe. No distinctive physical signs in abdomen.
- c. *Rapid fall of temperature*: frequently subnormal.
- d. *Pulse small, rapid, and running*.
- e. *Blood-pressure falls*, often 80 to 90 mm. Hg.
- f. *Stools*, bright blood or tarry. Passage often delayed from hours to one or two days after hæmorrhage. Death may occur before passage.
- g. Quiet delirium or mental 'wandering' is common.

Hæmorrhages not uncommonly repeated: may be numerous.

Leucocytosis occasionally present.

PROGNOSIS.—Always serious. Single hæmorrhage rarely fatal. Mortality, about 20 per cent with repeated or profuse bleeding. Peritonitis from perforation may follow (in about 20 per cent). Cause of death in 5 to 10 per cent of fatal cases.

7. PERFORATION OF TYPHOID ULCER.—

FREQUENCY.—Occurs in 3 to 4 per cent of cases. Causes 25 per cent (at least) of deaths from typhoid. Commoner in men than women.

AGE.—Rare over 40 years, and in young children.

TIME OF OCCURRENCE.—Usually in third week. Very rare earlier. Not infrequent in fourth or even fifth week if pyrexia persists. Very rare when temperature normal.

SITE.—Usually in ileum; commonly within 12 inches of ileocæcal valve. Occasionally in sigmoid and appendix. Rarely in other sites. *May be several perforations.*

CAUSE OF PERFORATION.—*Separation of sloughs*: slough often adherent to edge of perforation. Perforation may be pinpoint, or, less often, extensive from separation of large slough. Errors of diet, purgatives, sudden movements of body, etc., are oft-quoted exciting causes, but with present-day careful treatment are rarely present. Rupture of gut from intestinal distension is extremely rare. Necrosis of peritoneum or drag of adherent slough is cause almost invariably.

PREVIOUS COURSE OF ATTACK.—*Usually severe*: particularly with diarrhoea and with tympanites: associated with hæmorrhage not uncommonly. May occur in mild attacks.

SYMPTOMS.—Three stages often recognizable: (a) Shock immediately on perforation; (b) Latent period or 'period of repose'; (c) Symptoms of general peritonitis.

a. *Symptoms on Occurrence of Perforation.*—

- i. *Sudden severe abdominal pain*. In lower abdomen, usually in or near right fossa. Generally in paroxysms.

Typhoid—Abdominal Symptoms, *continued*.

- ii. *Sudden change* in constitutional and local conditions, with signs of shock. *Temperature* often falls temporarily: *pulse and respiration* more rapid: cold sweats: occasionally vomiting: may be *rigor*. *Abdominal tenderness* marked: may be local rigidity and muscular spasm: movement diminished. Blood-pressure rises. Bowels may be moved slightly.
- b. *Latent Period*.—Above symptoms often subside in one to two hours, and for a period of a few hours, while peritonitis develops, practically no symptoms may be present. *May be extremely deceptive*. Period of repose not always present, or incomplete, and the preceding and following stages merge.
- c. *Symptoms of General Peritonitis* (q.v.) develop.—If temperature has fallen initially, it usually rises again rapidly. Leucocytosis usually present: important in diagnosis, but may be absent.

DIAGNOSIS.—Usually not difficult. From: (a) *Hæmorrhage*: abdominal symptoms slighter, and blanching. May be very difficult, and may coexist. (b) *Appendicitis*: difficult, but differential diagnosis unimportant. (c) *Phlebitis* of iliac veins: very rare. (d) *Peritonitis* from other causes: very rare—e.g., rupture of mesenteric gland, typhoid septicæmia, or inflammation spreading through gut. (e) *Intestinal colic*: attacks may occur during convalescence, usually associated with constipation.

With extreme toxæmia, perforation may occur without symptoms, and be found at autopsy.

TREATMENT.—Immediate operation. Mortality very high, but diminishing with early diagnosis and improved surgery.

8. LIVER.—Lesions rare.

ACUTE CHOLECYSTITIS.—Symptoms: Pain, tenderness, and rigidity over gall-bladder. May be a tumour. Jaundice not constant. Result: recovery, suppuration, or rupture and peritonitis. Typhoid bacilli may be isolated in pure culture. Cholecystitis from typhoid bacilli may occur many years after attack.

GALL-STONES.—Not during attack, but subsequently occur more frequently in persons who have had typhoid, owing to persistence of typhoid bacilli in the gall-bladder.

JAUNDICE.—Definite jaundice is very rare.

ABSCESS OF LIVER.—Extremely rare. Due to secondary pyogenic infections. Never from typhoid bacilli.

Respiratory System.—

GROUPS.—(1) Epistaxis; (2) Bronchitis; (3) Lobar pneumonia; (4) Pleurisy; (5) Hypostatic congestion. Less common: (6) Bronchopneumonia; (7) Pulmonary embolism; (8) Laryngitis.

PHENOMENA OF MOST IMPORTANCE.—

FOR EARLY DIAGNOSIS.—Bronchitis; epistaxis.

COMPLICATIONS.—Lobar pneumonia in second or third week; hypostatic congestion.

1. EPISTAXIS.—Frequent early symptom: occurs in about 20 per cent: commoner in typhoid than in any other fever. Rarely serious.
 2. BRONCHITIS.—Important in diagnosis. *Presence at onset almost invariable. Physical signs: Crepitations at bases.* Symptoms slight, cough rarely troublesome and complaint rare. Lessens in second week. Not specially marked in fatal cases.
 3. LOBAR PNEUMONIA.—May occur at two stages:—
 - a. AT ONSET.—*Rare.* Illness may commence as typical lobar pneumonia: more frequently onset somewhat insidious. *Progress:* Defervescence usually does not occur, but occasionally there is a crisis, with subsequent rise. Clinical aspect alters. Pulmonary symptoms subside gradually, and intestinal symptoms become prominent. Condition may become typical of typhoid, or spots and agglutination reaction may decide diagnosis. In absence of spots diagnosis often difficult until late in course. Empyema apparently never follows.
 - b. AS COMPLICATION IN SECOND OR THIRD WEEK.—Considerably commoner than at onset. Occurs in 2 to 3 per cent of cases and in 5 per cent of deaths, case-mortality being about 30 per cent. Typical symptoms and rusty sputum usually absent: condition recognized by rapid respiration, cyanosis, physical signs, and often increased pyrexia. Occurrence of 'typhoid state' during ordinary lobar pneumonia must not be confused with these conditions.
- ETIOLOGY is doubtful. Typhoid bacillus frequently isolated from lung at autopsy, and from lung puncture during life. Pneumococcus probably always present.
4. PLEURISY.—Not common: in 1 to 2 per cent. May occur:—
 - a. AT ONSET.—Illness commences apparently as acute pleurisy, and, later, clinical condition alters, as with lobar pneumonia. Usually fibrinous: effusion is rare, and pus is extremely rare.
 - b. AS COMPLICATION IN LATER STAGES, most commonly during convalescence.—Symptoms of pleurisy less acute, but *empyema usually follows*, and *B. typhosus* may be present in pus.
 5. HYPOSTATIC CONGESTION.—Not uncommon in later periods. Prolonged recumbent position renders it frequent in feeble patients. Usually in severe attacks. Symptoms very slight or none, condition being discovered by examination. Physical signs: Impaired resonance at bases, feeble breath-sounds and vocal resonance; râles may be numerous. *Mortality* very high.
 6. BRONCHOPNEUMONIA.—Usually only as a terminal event: present in a considerable percentage of autopsies.
 7. PULMONARY EMBOLISM.—Rarely, in later stages with venous thrombosis.
 8. LARYNGITIS.—True typhoid ulceration occurs, though rarely.

Typhoid—Special Features and Symptoms, *continued*.

Nervous System.—The *mental state* is practically always affected, often profoundly, in all but very mild cases, and frequently for a period subsequent to attack. In *febrile stage* in ordinary forms, there is mental dullness with stupor or mild delirium. Sleep is almost continuous, insomnia being a severer condition. Can be roused without resentment. Mental condition also affected by the headache of onset and by the usual deafness.

The various changes can, in general, be referred to three stages :

(1) At onset ; (2) Febrile and toxic period ; (3) Convalescence.

MEMORY.—*At onset*, memory usually deficient, and patient's record of onset unreliable. Subsequent to attack, all memory of illness often lost, or a hazy recollection of a few incidents. Memory is impaired during convalescence.

DELIRIUM.—Rarely absent in severe cases.

1. **AT ONSET.**—Not common. In rare cases, during prodromal period and stage of onset (especially in 'ambulatory' form), confusion or delirium may be earliest symptom ; subject may wander far, do strange acts, or even be maniacal.

2. **IN FEBRILE PERIOD**, during second and third weeks or subsequently. Various types :—

a. Quiet delirium and stupor. Easily roused temporarily.

b. Restless and obstinate delirium without violence. May attempt continuously to get out of bed.

c. Low muttering delirium, in severe attacks.

d. Delirium tremens in drunkards. Apart from this, violent delirium is not common.

e. *Coma vigil* : Patient lies with open eyes, muttering and oblivious to surroundings. Incontinence of urine and faeces. Tremors of lips, tongue, and limbs. Twitching of fingers (carphologia). Picks at bed-clothes (subsultus tendinum). Is a sign of extreme toxæmia, and mortality very high.

Suicidal tendencies may be present even in mild delirium.

TYPHOID PSYCHOSES.—

1. Delirium and mental changes of onset and of febrile period, as above. (Delusions arising in febrile period occasionally persist into convalescence.)

2. **ASTHENIC PSYCHOSES OF CONVALESCENCE.**—More common after typhoid than other fevers. Some weakening of memory, and even of intelligence, may persist for many months : full mental powers frequently not regained under twelve months, but complete recovery with time.

'*Post-typhoid Insanity*'.—Dementia and various forms of insanity, such as monomania, may occur. Recovery is almost invariable.

'*Post-typhoid Neurasthenia*'.—May continue for months or years and completely prevent mental application. Most severe in neurotic persons, especially if convalescence shortened and return to work hurried ; in rare instances, may then be permanent.

Hysteria.—May occur : rarely serious.

MENINGEAL SYMPTOMS.—

1. MENINGISM.—Symptoms suggesting local affection of meninges may be extremely marked. More common in children. Usually at onset, very rare during course. *Due to congestion*; no gross anatomical lesions present.

Symptoms.—Severe headache, photophobia, head retraction, twitching of muscles, and, rarely, convulsions. Facial herpes not uncommon. Meningeal symptoms gradually subside, and those of typhoid develop. Degree of symptoms bears no relation to severity of attack of typhoid fever. At onset, always diagnosed as meningitis.

2. MENINGITIS.—Very rare. Occurs late in disease. Occasionally tuberculous or diplococcal.

CONVULSIONS.—Very rare. Causes various. May occur at onset, in children, or may result from meningism, or meningitis.

PERIPHERAL NEURITIS, ETC.—Peripheral neuritis occurs late in disease or during convalescence. Severe pain and swelling in affected area; most frequently extensors of lower extremity.

'TENDER TOES'.—Cause doubtful: may be due to local neuritis, or possibly neurasthenia. Tips of toes extremely sensitive to weight of bed-clothes; no swelling.

PAINFUL CRAMPS.—Not uncommon, especially in calves. Probably a myositis; rarely, perhaps, thrombosis of veins.

RARE NERVOUS SYMPTOMS.—

MULTIPLE NEURITIS.—Very rare. During convalescence. Rarely fatal.

APHASIA.—Occurs rarely in children. Prognosis good.

HEMIPLEGIA.—Probably due to thrombosis. Aphasia is generally present.

Special Senses.—

EYE.—Affections very rare. Loss of accommodation occasionally during convalescence. Conjunctivitis, optic neuritis, or retinal hæmorrhages may occur.

EAR.—Temporary deafness almost a constant symptom in early stages. Otitis media in about 3 per cent of cases. Serious results rare.

Renal System.—

CHANGES IN THE URINE.—Common febrile characteristics are present: excretion of chlorides diminished. *Polyuria* frequent during convalescence.

ABNORMAL CONSTITUENTS.—Albumin and casts (*see below*). Acetonuria without glycosuria may occur late, probably from starvation. Glycosuria occasionally during convalescence. (Ehrlich's diazo-reaction is of little value.)

RETENTION OF URINE.—A frequent early symptom. May cause abdominal pain. Suppression of urine is rare.

ALBUMINURIA.—Occurs in following conditions:—

1. FEBRILE ALBUMINURIA.—Occurs in majority of cases. Amount of albumin small. A few hyaline casts may be

Typhoid—Renal Symptoms, *continued*.

present. Most common in second week. May persist through convalescence. Kidney not permanently affected.

2. **NEPHRITIS.**—*Nephrotyphoid* is very rare. Ordinary symptoms of typhoid fever often slight and diagnosis very difficult. Is usually a transient hæmorrhagic nephritis without œdema. Chronic nephritis as sequel is very rare.

3. **PYURIA.**—From cystitis or pyelitis.

BACILLURIA, CYSTITIS, AND PYELITIS.

BACILLURIA from typhoid bacilli occurs frequently: about 20 per cent. Rarely before third week. Pus or albumin usually present. Urotropine is partial preventive. Persistence after normal convalescence is rare. Cystitis usually caused by *B. coli*; occasionally by typhoid bacillus.

Generative System.

ORCHITIS.—Rare. During convalescence in young adults. Atrophy unusual.

MASTITIS, OVARITIS, occur rarely.

Osseous System.

PERIOSTITIS may occur, usually in ribs or long bones. Painful node forms. Occurs in about 1 per cent. May subside or abscess form.

BONE LESIONS.—*Abscess of bones* may occur during convalescence, or more often subsequently, even many years later. Tibia, ribs, and femur most common sites. Onset with severe pain, redness, and swelling. Formation of abscess slow; recovery tedious; recurrence frequent. Pus usually contains typhoid bacillus, either in pure culture or with pyogenic organisms.

ARTHRITIS.—Monarticular or polyarticular. Hip most common. 'Typhoid dislocation of hip' may occur spontaneously.

'TYPHOID SPINE.'—Characterized by severe pain in lumbar and sacral regions. Almost confined to males of 15 to 30 years. Onset during convalescence, frequently after mild attack. Generally preceded by aching in back. *Severe pain*, often in agonizing paroxysms. *Spine rigid*. May be no physical signs; usually local tenderness. *Nervous and hysterical symptoms* often present, associated with the pain and insomnia. *X rays*: spondylitis and bony changes present in some cases, but not invariably. Definite spinal deformity may occur, rarely; usually kyphosis. Suppuration never present. Origin may be a peritonitis.

TREATMENT.—Complete rest. Immobilization of spine by jacket. Morphia for pain. Subsequent treatment as for fractured spine.

DURATION.—One to twelve months. *Recovery invariable*.

Muscles.—Zenker's degeneration may occur (*see MORBID ANATOMY*).

Post-typhoid Pyæmia and Septicæmia.—Some degree of pyæmia is not uncommon.

FURUNCULOSIS.—Often extensive and obstinate. More common after cold baths.

SUBCUTANEOUS ABSCESES may result from : *General pyæmia* following furunculosis or bedsores—staphylococcic ; *Typhoid abscesses*—bacillus present in pure culture.

Recurrent chills, late in disease, may be due to slight septic infections.

ASSOCIATION OF OTHER DISEASES AND MIXED INFECTIONS.

Most cases where typhoid fever appears to follow or coexist with other diseases are errors in diagnosis.

Malaria.—May occur with typhoid, but most cases are either typhoid or malaria, and not both. There is no specific typho-malarial fever.

Influenza.—May coexist during epidemics. Diagnosis of abdominal influenza from typhoid may be extremely difficult in sporadic cases.

Tuberculosis.—The following conditions may be recognized :—

1. Typhoid fever may simulate tuberculosis. Especially at onset with pleuritic or pulmonary symptoms.
2. Tuberculosis may simulate typhoid fever. Especially tuberculous meningitis and acute miliary tuberculosis. More rarely tuberculous peritonitis and tuberculosis of deep lymphatic glands.
3. Tuberculosis, acute or chronic, and typhoid fever may coexist. Tuberculous meningitis occasionally is terminal event in typhoid.
4. Pulmonary tuberculosis may follow typhoid fever. Dublin in New York finds that the death-rate from tuberculosis in the two years following typhoid fever is nearly three times the normal : subsequently rate unaffected.

VARIETIES OF TYPHOID FEVER.

The variation and complexity of the symptoms and course of typhoid fever have resulted in the description of many forms. These depend mainly on the exaggeration, modification, and localization of prominent symptoms. An unusual symptom may be present throughout an epidemic. The more definite varieties are :—

1. **Mild Form.**—Symptoms and course often typical, but greatly reduced in severity. In other cases a selection of typical symptoms. Agglutination reaction usually positive. Diagnosis may only be possible during an epidemic. Patient may not feel ill enough to go to bed. Rarely, the characteristic complications and sequelæ or relapses may occur and first reveal correct diagnosis.
2. **Abortive Form.**—May be a few days' pyrexia and malaise. Frequency with which agglutination reaction is positive is uncertain. Mild and abortive forms may become 'typhoid carriers', excreting virulent bacilli.
3. **Grave Forms.**—Severe nervous symptoms and high fever most frequent. Prostration may be extreme from commencement (adynamic form).

Typhoid—Varieties, *continued*.

Cases with intense localization of symptoms at onset are usually severe—e.g., pneumonic forms.

A general hæmorrhagic form occurs very rarely, with occasional recovery.

4. Ambulatory or Latent Forms.—(See MODES OF ONSET.)**5. An 'Afebrile' Form** is described. Extremely rare.

Typhoid Fever in Children.—Presents certain differences from that of adults. Such variations, described below, are most marked in infancy, and diminish up to 10 years of age. After this, disease approximates to adult type.

IN INFANTS UNDER TWO YEARS.—Rare. Diagnosis usually suggested by possibility of infection (as in epidemics) rather than by symptoms. Confirmed by agglutination reaction or isolation of bacillus. Mortality high in cases diagnosed (50 per cent).

IN CHILDHOOD.—Most frequent variations from adult type :—

MORBID ANATOMY.—Intestinal lesions not so marked. Ulceration may be absent. In undoubted typhoid, changes may not exceed those of simple diarrhœa.

MORTALITY.—Lower than adults : about 5 to 10 per cent.

ONSET.—Often sudden. Vomiting is common initial symptom. Condition may resemble other gastro-intestinal disturbances of childhood.

TEMPERATURE.—Initial rise frequently more rapid, curve less typical, duration shorter. Usually higher than in adult cases of same severity.

PULSE.—More rapid, but comparatively slow for febrile disease in children. Dicrotism rare.

RASH.—Less frequent, and is scanty.

SPLEEN.—Nearly always palpable.

GENERAL PROGRESS.—Symptoms milder. Condition usually stuporose. Marked delirium and nervous symptoms, such as 'typhoid state', rare. Meningitis may be closely simulated.

COMPLICATIONS AND SEQUELÆ.—Rare and mild. Hæmorrhage and perforation rare. So also otitis media. Chorea not uncommon. Temporary aphasia, without organic cause, is peculiar sequel : recovery in few weeks.

Typhoid Fever in the Aged.—Incidence rare. Fever not high and course usually atypical. Pneumonia and heart failure common. Mortality high.

Typhoid Fever in Pregnancy.—Pregnancy gives no immunity. Abortion in 70 per cent.

RELAPSES.

Occur in about 10 per cent of cases. Frequency varies in different epidemics.

1. **Ordinary or True Relapse.**—Occurs after temperature has become normal. Average interval five days: rarely exceeds two weeks. Diagnosed by presence of two of the triad: (a) Step-like temperature; (b) Rash; (c) Enlarged spleen. Relapse usually shorter and milder than original attack, but in rare instances is more severe. May be several relapses, becoming progressively milder. Duration seven to twenty-one days: occasionally longer.
2. **Intercurrent Relapse.**—Occurs before temperature has become normal. Often very severe. Complications not uncommon.
3. **Spurious Relapse, Recrudescence.**—Transient rises of temperature of a few hours' to one or two days' duration are not uncommon during convalescence. Occasionally connected with constipation, too rapid progress with diet, or excitement, but often no obvious cause: possibly a mild septic infection. May be slight malaise or no symptoms.

Recrudescences of temperature due to obvious boils, venous thrombosis, etc., are not relapses.

No satisfactory explanation for relapses is known, the blood at the time being strongly bactericidal to typhoid bacilli. Theories include: (1) Original infection with several strains of bacilli, against one or several of which immunity is not established, and such strain multiplies and causes relapse (Durham); (2) Re-infection by bacilli lingering in the gall-bladder—improbable.

DIAGNOSIS.

Methods of Diagnosis.—Typhoid fever is the most common of all long-continued fevers. There are three groups of data for diagnosis, depending on: (1) Symptoms and signs; (2) Bacteriological examination; and (3) Serological examination.

1. **SYMPTOMS AND SIGNS.**—The manifestations are extremely variable. No one symptom or sign is characteristic, except perhaps the rash. Most suggestive in early stages are: (a) Insidious onset; (b) Temperature curve; (c) Relatively slow pulse; (d) Headache; (e) Bronchitis. The typical triad of typhoid is: rash, enlarged spleen, and the temperature curve.

Blood.—Leucopenia with relative lymphocytosis.

2. **BACTERIOLOGICAL EXAMINATION.**—The isolation of *B. typhosus* is conclusive, but often difficult. (See BACTERIOLOGY.)

a. FROM THE BLOOD.—Initial stage of typhoid is a septicæmia, and bacilli are present in the blood: after a few days bacilli become localized in internal organs. Bacilli can be isolated from blood cultures in first few days, rarely after the fifth. Earliest absolute proof of disease.

b. FROM THE STOOLS.—Not present in early days. Almost invariably present later, but isolation not always easy.

c. FROM THE URINE.—Present in nearly one-third of cases, but only in later stages. Rarely in large numbers.

3. **AGGLUTINATION REACTION (Widal).**—(a) Positive reaction is not obtained before the seventh or eighth day; agglutinins rise rapidly to maximum in third week and then commence to fall, at first rapidly. (b) Reaction is positive in 95 per cent,

Typhoid—Diagnosis—Agglutination Reaction, *continued*.

at least, of cases with clinical symptoms. (c) Positive reaction is occasionally delayed until a relapse or convalescence. (d) Positive reaction is extremely rare in conditions other than typhoid. In 'abortive' forms incidence unknown.

A 'positive reaction' represents an increase of agglutinins not only above the titre of normal serum, but also above the titre which may occur in other diseases. Hence a *quantitative* test is necessary. *Complete agglutination in dilution of serum 1-50 is a positive result.* For diagnostic purposes, serum should be tested against T.A.B. and *B. abortus*.

DIFFICULTIES MAY ARISE FROM :—

- a. Doubtful reactions.—Test should be repeated. May be too early in disease, or due to production of a certain amount of agglutinins occurring in other diseases with high fever, e.g., pneumonia, tuberculous meningitis.
- b. Previous antityphoid inoculation.
- c. Paratyphoid infections. (See p. 31.)

Types of Antigens and Agglutinins.—The enteric group of bacilli contain (as do other flagellated bacilli) an antigen in the body known as somatic or 'O' (*ohne Hauch*) and an antigen in the flagella known as flagellar or 'H' (*Hauch*). Agglutinins form independently to these two antigens and can be separately estimated in serum with the respective antigens.

H AGGLUTININS.—

1. Are not present in normal human serum (rarely, in low titre).
2. Are specific for one organism, e.g., *B. typhosus*. Hence, in an uninoculated person their presence is proof of infection with the homologous organism.
3. Are produced by inoculation with the vaccine of the organism. At any interval after such inoculation may be present and rise to high titre: hence must be disregarded as a test of infection.

O AGGLUTININS.—

1. Are present in normal serum and may rise further with other infections, e.g., pneumonia.
2. Are not specific for separate members of enteric group, i.e., are 'group agglutinins'. Thus infection with *B. typhosus* will or may produce O agglutinins to paratyphoid A and paratyphoid B.
3. Are not produced by inoculation with vaccines. Hence presence in appropriate dilutions either in uninoculated or inoculated persons is evidence of 'enteric group' infection, but cannot definitely identify exact bacillus.

Differential Diagnosis.—*Difficulties in diagnosis* arise from: (1) Localization of symptoms in special organs at onset; (2) The general symptoms and course. A correct diagnosis is often impossible for some days.

Specific tests are not mentioned in this section.

1. LOCALIZATION OF SYMPTOMS.—Diagnosis has to be made especially from the following conditions :—

a. PNEUMONIA.—*Pneumonia at onset* may completely mask other symptoms, but an initial pneumonia is a rare mode of onset, and the common error is diagnosing pneumonia as typhoid. Bronchitis, a constant symptom, and pleurisy occasionally cause error.

b. MENINGEAL SYMPTOMS.—Lumbar puncture may clinch the diagnosis, by cytology or bacteriology.

c. APPENDICITIS.—Typhoid may commence with constipation and pain in right iliac fossa.

2. GENERAL SYMPTOMS AND COURSE.—

a. TUBERCULOSIS.—The usual error is diagnosing tuberculosis as typhoid: the reverse is less frequent.

Acute General Miliary Tuberculosis.—Temperature usually more irregular. Pulse more rapid. Polymuclear leucocytosis often present.—The abdominal symptoms may be closely similar, with constipation and palpable spleen. The pulmonary form is more distinct, with definite dyspnoea and cyanosis. (See also MILIARY TUBERCULOSIS, p. 136.)

Glandular Tuberculosis.—Especially of abdominal and deep glands. May simulate typhoid for a period.

Tuberculous Peritonitis.—This may simulate typhoid fever when occurring with acute onset.

Tuberculous Meningitis (see p. 138).—Vomiting is frequent early, the abdomen is retracted, and the temperature is irregular. Inequality of pupils and squint are common. Lumbar puncture decides the diagnosis.

b. SEPTICÆMIC CONDITIONS.—Note in general: (i) Onset more abrupt; (ii) Temperature less regular; (iii) Pulse rapid from onset; (iv) Sweats and rigors frequent; (v) Leucocytosis common; (vi) Etiological factor may be present, e.g., septic foci; (vii) Progress often rapid.

General Septicæmia or Pyæmia.

Otitis Media.

Osteomyelitis.—Local pain and tenderness.

Puerperal Septicæmia.—Especially as abortion often occurs in typhoid.

Infective Endocarditis.—May be extremely difficult, but onset and progress usually less rapid. In acute forms, purpura and hæmorrhages common. Blood cultures may be positive. Leucocytosis often absent.

c. GASTRO-INTESTINAL CONDITIONS.—

Gastro-enteritis and Colitis of all grades, from transient disturbances to acute infections with dysentery, and food-poisoning bacilli. The difficulty is mainly in the milder forms, severe types being very acute.

Appendicitis.

Various Affections of the Abdominal Glands (rarely)—e.g., tuberculosis, Hodgkin's disease.

d. INFLUENZA.—Onset more acute, and respiratory and upper air-passages more affected. Spleen may be palpable. 'Abdominal influenza' is very rare.

Typhoid—Differential Diagnosis, *continued*.

- e. **MALARIA**.—Especially in malignant tertian type.
- f. **ACUTE EXANTHEMATA**.—Rarely difficult, except with mild forms of typhus and adult glandular fever.
- g. **UNDULANT FEVER**.—No spots. Temperature less regular, pulse more rapid. Shorter course with relapses. Geographical distribution (*see* UNDULANT FEVERS, p. 95).
- h. **SPIROCHÆTOSIS ICTEROHÆMORRHAGICA**.—Acute onset: early severe jaundice. Jaundice is very rare in typhoid.

PROGNOSIS.

1. **Death-rate**.—*In hospitals*, should not exceed 15 per cent. Rate is lowest (5 to 10 per cent) between 5 and 10 years. Generally low towards end of epidemics. Severity of epidemics varies.

Mortality higher in hot weather, in fat people, in women than in men, and very high in ambulatory type and in alcoholics. Increased by any pre-existing disease such as diabetes.

Even in mild cases death may result from hæmorrhage or perforation, or symptoms become severe in third week, or rarely during a relapse.

Sudden death is rare, about 3 per cent of fatal cases. May occur in later febrile stages from cardiac failure, usually in males. In convalescence, generally due to pulmonary embolism.

2. **Special Features in Prognosis**.—Serious symptoms are mainly dependent on degree of toxæmia and on complications.

NERVOUS SYMPTOMS.—Any definite delirium is serious. In 'coma vigil', mortality very high. Low muttering delirium with tremor, restless delirium, or delirium tremens also serious. Early onset of nervous symptoms unfavourable.

PULSE.—Pulse-rate constantly over 120 is serious, and prognosis is worse as rate increases. Weakness of first sound is early sign of cardiac failure: a soft systolic murmur has little importance. Irregularity a bad sign. The pulse-rate is a measure of toxæmia. In children, of less importance.

TEMPERATURE.—Hyperpyrexia (over 106°) is serious. High temperature below this without other severe symptoms is of slight importance if not prolonged.

ABDOMINAL SYMPTOMS.—(a) *Meteorism*, when marked, is a sign of toxæmia. (b) *Diarrhæa*: mortality higher than with constipation.

PULMONARY SYMPTOMS.—(a) Hypostatic congestion, and (b) late lobar pneumonia, have high mortality.

COMPLICATIONS.—(a) Hæmorrhage; (b) Perforation: mortality very high. The rarer complications are not often serious.

Of little value in prognosis are: profuse rash, initial bronchitis, dicrotic pulse.

PROPHYLAXIS.

Typhoid fever can be completely stamped out by: (a) Recognition of all cases, including typhoid carriers; (b) Destruction of all bacilli leaving a patient. Prophylaxis deals with: (1) Control of epidemics; (2) Prevention of direct infection from a patient.

- 1. Control of Epidemics.**—Epidemics are spread by, and attention must be directed to :—

WATER-SUPPLY.—Defective sanitation causes large epidemics, for a contaminated water-supply only remains infective for a limited period unless the contamination is repeated. During an epidemic, all drinking water and milk must be boiled. Light wine is safe, and mineral water. Also siphon soda-water after fourteen days' standing, but not earlier.

TYPHOID CARRIERS.—Especially cooks and dairy employees.
FLIES.

FOOD.—Including milk, oysters, and vegetables.

DIRECT INFECTION.

- 2. Prevention of Direct Infection from Patient.**—Stools and urine commonly contain typhoid bacilli. Disinfection is directed toward these and any articles which may be contaminated by them. All excreta must be carefully sterilized before disposal.

STOOLS, URINE, AND SPUTUM.—Empty into covered pail containing antiseptics—e.g., crude cresol (cheapest) or carbolic acid—and leave at least two hours. The carbolic acid should not be more dilute than 1-80 after addition of excreta. The urinals and bed-pans must be washed with antiseptics, and if possible allowed to stand in them until required: the bed-pans may be scalded. Great care is necessary to prevent spilling of urine.

FEEDING VESSELS must be kept apart.

LINEN.—Soak in 1-20 carbolic for two hours, and boil.

NURSES and others must wash their hands carefully after any contact with a patient, and especially before taking food. Scrubbing with a nail-brush is sufficient: perfunctory dipping the fingers in an antiseptic is reprehensible. No one in attendance on a typhoid patient should take any part in preparation of food for other patients.

ISOLATION.—It is justifiable to nurse patients in a private house or a general ward if the rules for sterilizing excreta and washing the hands are carried out with due care.

No patient should be discharged or regarded as non-infective until bacteriological examinations of the stools and urine are negative.

Antityphoid Inoculation.—Vaccines in present use always contain paratyphoid bacilli (and may contain cholera). Two or three injections are given at intervals of about one week. The usual initial dose is 500 million of *B. typhosus* and 250 million of each paratyphoid: subsequent injections are double this (dosage for healthy adults).

LOCAL REACTION AND CONSTITUTIONAL SYMPTOMS commence in four to six hours and last one to three days. The degree varies greatly in different individuals, some showing marked local reaction, and others constitutional symptoms with little local change. The local reaction is swelling, pain, and redness; when severe, the appearance suggests sepsis, but it subsides in a few days, fomentations easing the pain. The reaction is usually considerably less after the second injection. Risks are negligible.

Typhoid—Prophylaxis, *continued*.

RESULTS OF ANTITYPHOID INOCULATION.—The case-incidence is reduced to one-fifteenth, the course is modified, and the case-mortality does not exceed 2 to 3 per cent.

PROTECTION is high for one year. After this it varies in different individuals, but is often considerable for two years.

TREATMENT.

This is considered under: (1) General management; (2) Diet; (3) Hydrotherapy; (4) Medicinal treatment; (5) Treatment of special symptoms; (6) Management of convalescence; (7) Serum treatment. No treatment will abort an attack, but skilful nursing, hydrotherapy, and avoidance of purgatives and unnecessary drugs will lower the mortality.

1. General Management.—The room should contain no unnecessary furniture, be freely ventilated, and maintained at equable temperature, when possible about 60° F. There must be absolute confinement to bed until convalescence is established, about three weeks after temperature is normal. The use of the bed-pan is essential. The bed-clothes must be light: one, or at most two, blankets are sufficient, and one pillow. A hair mattress is best. Smoothness of bed-clothes is essential, the slightest crease tending to bedsores in toxic patients. A rubber cloth should be placed under the bed-sheet; in severe cases, a water-bed. The mouth must be cleansed after each feed. The patient should be turned from one side to the other every few hours when stuporose, to prevent hypostatic pneumonia. Must be sponged all over daily. Catheterize if retention.

2. Diet.—The general febrile catarrh of the alimentary tract impairs assimilation of food. Also, *undigested* solid matter may cause hæmorrhage or perforation of ulcers, probably mainly by increase of peristalsis. The risk is less than was formerly supposed, and modern diet is becoming more liberal; but all articles must be easily digestible. General principles:—

DURING FEBRILE PERIOD.—

a. Milk must form the basis of all diets.

b. It is unnecessary to adhere to a strict milk diet as an absolute routine. Additional articles permissible: eggs, custard, junket, mashed potatoes, arrowroot (two teaspoonfuls to a feed of milk). *Sugar* is of special advantage owing to high value in calories, and can be administered as (i) lactose added to milk, (ii) chocolate, (iii) lemonade. Meat extracts are best avoided.

c. These additional articles can be given throughout in mild cases. In cases of ordinary severity, sparingly until temperature commences to fall (except sugar). The diet should then contain, if possible, 2500 to 3000 calories.

d. Solid food is unnecessary, but small amounts of thin bread-and-butter and biscuits are permissible in later stages.

e. Diarrhœa needs stricter dieting than constipation.

- f. Watch stools carefully : if milk-clots appear, reduce or dilute milk ; if persisting, give whey or peptonized milk for a few days. *For meteorism* : similar diet and omit sugar.
- g. *Fluid to be given plentifully*. Should be several pints daily, but not in large quantities at one time. As soda-water, barley-water, or well given as lemonade containing sugar.

ADMINISTRATION OF MILK FOOD.—Three pints of milk daily. Give 5 ounces, diluted with half volume of water, every two hours, day and night. To each feed, add full teaspoonful of lactose. Flavouring of coffee or tea may be added.

If asleep, patient must be aroused carefully (or food may enter larynx) : subsequently will sleep again immediately.

The mouth must be cleansed after each feed with glycerin and borax, hydrogen peroxide, or weak carbolic acid.

IN CONVALESCENCE.—After temperature has been normal for 3 days, give bread-and-butter (if not previously) ; for 5 days, pounded boiled fish ; for 10 to 14 days, minced chicken. A large diet should then be given, but of simple nutritious articles, and return to a full ordinary diet be gradual.

Alcohol.—Unnecessary as routine. With cardiac weakness or severe nervous symptoms, give whisky up to 8 ounces daily.

3. Hydrotherapy.—Is of great value ; mortality greatly reduced.

INDICATIONS.—High temperature, nervous symptoms.

RULES FOR PRACTICE.—(a) Sponging above 102.5° ; (b) Bathing above 104° , every four hours. A feed should always be given subsequently.

CONTRA-INDICATIONS FOR BATH : Great weakness, irregular pulse, severe abdominal pain, hæmorrhage, peritonitis, and venous thrombosis.

a. SPONGING.—This may be with—

TEPID WATER.—Soothes and slightly tires patient. Sleep follows. Temperature but little reduced. Easily performed.

COLD WATER.—Unpleasant to patient. Temperature reduced, but may rise occasionally, owing to closure of peripheral circulation. A substitute for cold bath when latter is impossible in practice.

Sponging should occupy fifteen minutes.

b. BATHING.—Bath may be :—

i. AT TEMPERATURE OF 85° .—Patient shivers. *Limbs and chest must be rubbed during bath*. Duration : 10 to 15 minutes. Temperature in rectum falls 2° , and another 2° after return to bed.

ii. AT TEMPERATURE OF PATIENT, and then reduced by addition of ice. Rectal temperature falls 2° .

Pulse must be watched in bath. If it weakens and becomes irregular, return patient to bed and give stimulants.

Hydrotherapy improves pulse, lessens delirium, promotes sleep, stimulates the kidneys, and by these means reduces mortality. Lowering of temperature is not important result. Relapses and boils are possibly more frequent.

Typhoid—Treatment, *continued*.

4. Medicinal Treatment.—The administration of drugs in typhoid fever is dictated more often by ignorance and inexperience than by skill and observation. There is no specific remedy, and drugs should never be employed needlessly. Pills should never be given.

PURGATIVES are contra-indicated (*see* SPECIAL SYMPTOMS, p. 12).

ANTI-PYRETICS.—Quinine (gr. v) probably does no harm. Other antipyretics are contra-indicated. Mere reduction of temperature is valueless, and collapse may occur.

INTESTINAL ANTISEPTICS are justifiable, but not necessary, if stools be offensive. Their value is unproved, and the excretion of typhoid bacilli is not diminished. Salol (gr. v, t.d.s.) or β -naphthol and others can be given safely.

HEXAMINE (urotropine) is well given in third week, for action as urinary antiseptic (gr. x, t.d.s.). Valueless unless urine is acid.

5. Treatment of Special Symptoms.—

HEADACHE.—If severe, cold compresses to head.

INSOMNIA.—Sponging or tubbing most efficacious.

DELIRIUM AND EXTREME RESTLESSNESS.—*Hydrotherapy*. Hypodermic of morphia (especially to procure sleep). Patient must be watched carefully.

TOXÆMIA.—*Hydrotherapy*. Water freely by mouth. *Whisky*, 4 to 10 oz.

HYPERPYREXIA.—*Hydrotherapy*. Avoid antipyretics.

ABDOMINAL PAIN.—Fomentations or turpentine stupes.

TYMPANITES.—*Diet*: albumen-water or whey; no sugar, Turpentine enema or stupes. If severe, *pituitary extract*, 1 c.c., intramuscularly or hypodermically; may be repeated four-hourly. Passage of rectal tube has only temporary effect. Injections of *B. welchii* antiserum.

DIARRHŒA.—Examine stools for milk curds: if present, reduce or dilute milk, or give whey or albumen-water for a few days.

FOR SEVERE DIARRHŒA, exceeding four motions a day: (i) Daily starch and opium (tinct. opii 3ss to 3j) enema (often valuable); or (ii) Aromatic chalk by the mouth (e.g., mist. cretæ (B.P.) or pulvis cretæ aromaticæ). Opium by the mouth is best avoided.

CONSTIPATION.—Never harmful. Enema daily or every second day. Never give purgatives.

INTESTINAL HÆMORRHAGE.—(i) *Rest—must be absolute*. (ii) Opium. Inject morphia, gr. $\frac{1}{4}$. (*Note*.—The objection to opium is that it may increase meteorism and also mask symptoms of perforation, which occurs in 20 per cent of cases of hæmorrhage. The advantages are that it quiets the patient mentally, and diminishes peristalsis.) (iii) Blood transfusion, and usual treatment of severe hæmorrhage. Liable to bedsores and hypostatic congestion.

PERFORATION.—Immediate operation.

CARDIAC WEAKNESS.—*Hydrotherapy*, alcohol, stimulants.

VENOUS THROMBOSIS.—Absolute rest in bed. Limb elevated on inclined plane and wrapped in cotton-wool. Potassium citrate by the mouth is of no value as a preventive.

BACILLURIA.—Urotropine (gr. x, t.d.s.) in hot water after food.

BONE LESIONS and ABSCESES.—Aspiration and typhoid vaccine to be tried. Operation if performed must be thorough.

- 6. The Management of Convalescence.**—The progress of convalescence must be slow. The temperature should be taken for at least two weeks after becoming normal. Patient may sit up for a few minutes after ten to fourteen days of normal temperature: further progress will be dictated by his strength.

RELAPSES.—Treatment as in original attack.

COMPLICATIONS OF CONVALESCENCE.—Constipation: treat by enemata. Diarrhoea: restrict diet; confine to bed; chalk or bismuth by mouth.

- 7. Serum Treatment.**—Felix's serum is under trial: is prepared with a special enteric antigen known as *Vi*, of greater virulence than H and O antigens (see p. 22). Dose: 25 c.c. on three successive days: double may be given.

PARATYPHOID FEVER.

Paratyphoid fever results from infection with one of the paratyphoid bacilli. Three strains recognized, paratyphoid A, B, and C. The condition closely resembles typhoid fever, but tends to be milder. Toxic cases, complications, and fatal results are all unusual. The course for para A and B is still further modified after inoculation with a mixed typhoid-paratyphoid vaccine (T.A.B.). Under MORBID ANATOMY and SYMPTOMS the common differences from typhoid fever are noted. No useful clinical distinction can be drawn between para A and B infection, but para C tends to be septicæmic and is also serologically distinct.

Note.—The term 'typhoid' is now being confined, with convenience, by many authorities, to infections by *B. typhosus*, the term 'enteric' including infections by *B. typhosus* and the paratyphoid bacilli.

Distribution of Paratyphoid Fever.—Para B has approximately the same distribution as *B. typhosus*, but is less common in tropical than subtropical countries. Para A is rare in Europe and America, but not uncommon in India. Para C is rare.

Bacteriology.—

MORPHOLOGY and METHODS OF ISOLATION.—As for *B. typhosus*.

CULTURAL CHARACTERISTICS.—

1. No change in: *lactose*, *saccharose*, *inulin*.
2. Produce acid and gas in: *dextrose*, *mannite*, *dulcite*, *maltose*.
3. No formation of indole.
4. Action on milk: *B. paratyphosus A*—permanent acidity; *B. paratyphosus B* and *C*—slight initial acidity, permanent alkalinity commencing on third day.

Note.—*B. paratyphosus B* can be distinguished from *B. aertrycke* only by 'absorption' tests. *B. paratyphosus C* also identical culturally and morphologically.

Paratyphoid—Bacteriology, continued.

PARATYPHOID C.—*B. paratyphosus C* may be isolated from almost typical enteric, but has a tendency to atypical forms; has also been isolated from diarrhoeal, pulmonary, and various septic conditions without enteric symptoms. Thus differs from other enteric bacilli in its clinical manifestations. Also differs serologically. In infections or inoculations with *B. paratyphosus C*, serum contains no group agglutinins—i.e., does not agglutinate T, A, or B (last occasionally slightly); agglutinins to *B. paratyphosus C* itself may be absent, and diagnosis depend on isolation of bacillus. *B. paratyphosus C* is also not agglutinated by T, A, or B antisera (last occasionally slightly). Typical strains of *B. paratyphosus C* and of *B. suipestifer* may be indistinguishable even by absorption, but *B. paratyphosus C* is certainly not identical with *B. ærtrycke*, which also in some strains cannot be distinguished from *B. suipestifer*.

Morbid Anatomy.—The colon is more frequently affected than in uninoculated typhoid fever. Catarrh of the intestine without actual ulceration may be present.

Symptoms.—The clinical course in rare cases may be identical with ordinary or even severe forms of *B. typhosus* infection. Usually it is considerably milder.

DIFFERENCES FROM 'TYPHOID FEVER'.—The following refer to paratyphoid fever of moderate severity, occurring in persons not inoculated with paratyphoid vaccine.

1. **ONSET.**—Often more rapid.
2. **RASH.**—Occasionally very profuse, with large spots (or small areas) of irregular outline, of deeper colour than typhoid, or sometimes a bluish tinge, not entirely fading on pressure, and leaving a slight stain: may almost resemble measles.
3. **TEMPERATURE.**—Rise more rapid: often 104° to 105° in a few days. Course more irregular, and sustained fastigium unusual. Fall more rapid. Duration about two weeks.
4. **PULSE.**—Frequently very slow throughout.
5. **SPLEEN.**—Enlargement may be marked. May be tender.
6. **SWEATING and SHIVERING** more common.
7. **TOXÆMIA** rare. Patients with temperature of 104° and a profuse rash often exhibit no toxic symptoms or psychological disturbance, and feel well after first few days.

DIARRHŒAL AND DYSENTERIC ONSET.—Slight diarrhœa not uncommon at onset. Instances occur with acute onset and diarrhœa of dysenteric or food-poisoning type. These only occur in sporadic cases, paratyphoid never producing an outbreak of such type, alleged occurrence being due to confusion of paratyphoid and food-poisoning bacilli (*see p. 32*).

Complications.—As in typhoid fever, but of far greater rarity. The incidence is further reduced by paratyphoid inoculation.

Diagnosis.—General diagnosis as in typhoid fever. Differentiation from typhoid fever and between paratyphoid A and B rests entirely on bacteriological and serological tests. The general diagnosis often depends on these tests.

ENTERIC FEVER IN INOCULATED PERSONS.

The clinical course of enteric fever, both typhoid and paratyphoid infections, is greatly modified during period of protection by previous inoculation. The condition is usually extremely mild, relapses are unusual, and complications rare. Mortality about 1 per cent. The course may be of a few days' duration only, and all degrees exist, from slight transient malaise to, in very rare instances, typical enteric.

Symptoms frequently are pyrexia with persistent slow pulse, a furred tongue, and a doughy abdomen.

AGGLUTINATION REACTIONS IN ENTERIC GROUP (T.A.B.).

Agglutination reactions in the enteric group are complicated by the occurrence of group or O agglutinins. See p. 22.

'Absorption' of Agglutinins.—The agglutinins to any bacillus can be removed from a serum by the method of 'absorption'. The serum is saturated by the addition of a large number of the bacilli, incubated, allowed to stand for twenty-four hours, centrifuged, and the supernatant serum pipetted off. Result of absorption : (1) If the bacillus used for absorption be the specific bacillus, both the specific and the group agglutinins are removed ; (2) If the bacillus used be a heterologous bacillus, only the group agglutinins for that bacillus are removed.

Example.—A serum prepared by inoculating an animal with *B. typhosus* contains both specific agglutinins to *B. typhosus* and group agglutinins to *B. paratyphosus* B. (a) After absorption with the specific organism *B. typhosus*, serum agglutinates neither *B. typhosus* nor *B. paratyphosus* B. (b) After absorption with the heterologous organism *B. paratyphosus* B, serum does not agglutinate *B. paratyphosus* B, but still agglutinates *B. typhosus*.

THE METHOD CAN BE APPLIED :—

1. To ascertain which is the specific bacillus of a serum, e.g., in an attack of enteric.
2. To ascertain the identity or otherwise of two strains of bacilli which are both agglutinated by a serum.

Summary of Specific (H) and Group (O) Agglutinins in Human Enteric Infections.

1. INFECTIONS WITH *B. typhosus*.—Serum with cultures of :—
B. typhosus.—Complete agglutination in 1-50. Often much higher.
B. paratyphosus A.—Group agglutinins absent or very slight.
B. paratyphosus B.—Group agglutinins common. Occasionally titre as high as to *B. typhosus*.
2. INFECTIONS WITH *B. paratyphosus* A.—Serum with :—
B. typhosus.—Group agglutinins common. Titre may be as high as in *B. typhosus* infections (but usually for few days only).

Agglutination Reactions in Enteric Infections, continued.

B. paratyphosus A.—Agglutinins tend to develop late, to be transient, and to be in low titre, rarely exceeding 1-40.

B. paratyphosus B.—As for *B. typhosus*.

3. INFECTIONS WITH *B. paratyphosus B.*—Serum with:—

B. typhosus.—Group agglutinins common. Titre may be as high as in *B. typhosus* infections.

B. paratyphosus A.—Group agglutinins absent or very slight.

B. paratyphosus B.—Complete agglutination in 1-50. Often much higher.

Agglutination in 1-50 with one bacillus, and no agglutination to other bacilli of the group, may reasonably be accepted as due to infection with that bacillus.

AGGLUTINATION REACTIONS IN INOCULATED PERSONS.

After inoculation H agglutinins are present to the T.A.B. group. The titre and the duration of these agglutinins vary greatly. The agglutinin-forming mechanism is in a highly sensitive condition, and liable to sudden activity with rise in titre in any illness, or even in health: may remain so for years. Variations can only be accepted as evidence of enteric infection when the titres are very high, and they are rarely conclusive.

IDENTIFICATION OF ENTERIC, DYSENTERY, AND FOOD-POISONING BACILLI.

Three Groups.—(1) Enteric bacilli: *B. typhosus*, *B. paratyphosus A*, *B*, and *C*. (2) Dysentery bacilli: Shiga and Flexner strains. (3) Food-poisoning bacilli.

Methods of Differentiation.—(1) Cultural characteristics. (2) Agglutination with specific antisera. (3) Absorption of agglutinins in antisera (see AGGLUTINATION REACTIONS, p. 31).

Summary of Methods of Identification.—**1. ENTERIC GROUP.—**

Specific antisera will distinguish the four types from each other.

Cultural distinctions: *B. typhosus* produces no gas in carbohydrates. The paratyphoids produce gas in certain carbohydrates, but differ in action on milk, *A* causing permanent acidity, *B* and *C* a final alkalinity.

B. paratyphosus B has cultural characteristics identical with the food-poisoning group, and is agglutinated by *B. aertrycke* antisera. *Distinction necessitates absorption test.* *B. paratyphosus C* is usually not agglutinated by *B. paratyphosus B* antiserum.

Certain non-pathogenic bacilli closely resemble the paratyphoids, but have no action on dultice and are not agglutinated by paratyphoid antisera.

2. **DYSENTERY BACILLI.**—Produce no gas in carbohydrates, and thus differ from paratyphoid and food-poisoning bacilli. Flexner and other strains distinguished from *B. typhosus* by agglutination with antisera.
3. **FOOD-POISONING BACILLI** (*see also* FOOD POISONING.—The cultural characteristics of the following bacilli are identical: (a) *B. enteritidis* (Gaertner). (b) *B. suipestifer*, the bacillus of hog cholera or swine fever (*B. aertrycke*). (c) *B. paratyphosus* B and C.

Gaertner's bacillus is readily distinguished from the others by agglutination with specific antisera.

The remaining members are all agglutinated to the same degree by antisera prepared for any one of them. Absorption of agglutinins (originally carried out by Bainbridge) gives the following results: *B. aertrycke* and *B. suipestifer* are indistinguishable; *B. paratyphosus* B is a different organism from these. For *B. paratyphosus* C, *see* p. 30.

'**Salmonella Group**'.—The three bacilli, Gaertner, *aertrycke*, and *paratyphosus* B, have been grouped together as the 'Salmonella' or 'food-poisoning group'. The classification is unwise and erroneous: *paratyphosus* B does not cause an outbreak of 'food-poisoning' or of acute enteritis, although sporadic cases may resemble this; and it is not a 'food-poisoning' organism, reputed epidemics being due to lack of distinction from *B. aertrycke*.

The 'food-poisoning bacilli' are thus Gaertner and *B. aertrycke*. Of *B. aertrycke* several strains have already been recognized—e.g., Newport (Schültze), Mutton (Hutchens)—and the agglutinations with antisera, both before and after absorption, vary to some degree for the different strains.

CHAPTER II.

SEPTICÆMIA. PYÆMIA. TOXÆMIA.

Conditions in which a group of constitutional symptoms occur, with or without local manifestations of suppuration, due to the action of various micro-organisms, usually of the common pyogenic bacteria.

Three Groups are recognizable:—

1. **SEPTICÆMIA.**—Characterized by presence and multiplication of organisms within the blood and by the absence of local abscess formation.
2. **PYÆMIA.**—Characterized by occurrence of multiple abscesses in the superficial tissues and internal organs.
3. **TOXÆMIA.**—The organisms are confined to a focus, whence their toxins enter the circulation—e.g., in diphtheria.

The groups are artificial to a considerable extent, intermediate and unclassifiable conditions being common.

SEPTICÆMIA.

Etiology.—May arise from:—

1. LOCAL FOCI OF INFECTION.—Usually conditions without local formation of pus—e.g., post-mortem wounds—permitting the entry of organisms into the circulation. Also endocarditis.
2. 'CRYPTOGENIC' INFECTION.—Site or cause of entry not discoverable: subjects usually debilitated.

Bacteriology.—*Streptococci* most common, especially hæmolytic strains. Numerous bacteria occur—e.g., pneumococcus, staphylococcus, and bacilli of the coli-typhoid group.

Morbid Anatomy.—*Blood* often fluid and dark. *Spleen* large and soft. *Petechial hæmorrhages* common: especially on serous membranes. *Arterial walls* stained. *Kidneys* and other organs show cloudy swelling.

General Characteristics.—(1) *Rigors* and *sweats*. (2) *Pyrexia*: May be daily remissions or intermissions, or steady rise. (3) *Pulse*: Small, soft, and rapid. (4) *Gastro-intestinal disturbances*: Furred tongue, often dry; anorexia; constipation. (5) *Prostration* marked; rapid wasting. (6) *Mental symptoms*: Delirium if debilitated; may remain mentally clear. (7) *Pallor*. Conjunctivæ may be icteroid. (8) *Hæmorrhages*, petechial or purpuric. Transient erythemata, etc., may occur. (9) *Leucocytosis*: (a) Total leucocytes increased (10,000 to 100,000 per c.mm.): (a) Polynuclear cells relatively increased (up to 90 per cent or higher). (10) *Urine*: Albuminuria rarely absent.

In Very Acute Forms 'typhoid state' develops. Severe symptoms are: (1) *Skin* dry. (2) *Pulse* very small, soft, rapid, and 'running'. (3) *Temperature*: May either rise steadily or fall to subnormal. (4) *Prostration* extreme. *Delirium* usual. (5) *Diarrhæa* and *vomiting*. (6) *Jaundice*; hæmorrhages; hæmaturia. (7) *Blood*: Leucocytosis may be absent; may be definite leucopenia (1000 to 4000 cells per c.mm.) combined with high percentage of polynuclear cells.

Milder degrees of symptoms in all grades may occur.

Staphylococcal septicæmia may simulate rheumatic fever: always fatal.

Treatment.—See p. 35.

PYÆMIA.

Etiology.—*Focus of suppuration* present—e.g., boils, septic wound, osteomyelitis, otitis media, appendicitis, septic arthritis. Spread of organisms due to septic emboli, thus: (a) From suppuration in portal system abscesses form in liver; (b) From external wounds, etc., suppuration spreads into general circulation.

Bacteriology.—*Staphylococci* predominate. *Streptococci* occasionally, and other organisms rarely, as in septicæmia.

General Characteristics.—

1. GENERAL SYMPTOMS.—Resemble those of septicæmia. Sweats and rigors marked. Also superficial abscesses.

2. LOCAL SYMPTOMS, due to septic emboli, and local abscess formation. Especially: (a) In lungs—dyspnoea, cough, and hæmoptysis; (b) Pleurisy; (c) Pericarditis; (d) Spleen enlarged and painful; (e) Hæmaturia; (f) Cerebral abscesses.

Diagnosis.—

SPECIAL METHODS.—(1) Blood culture; (2) Blood count; (3) Agglutination for enteric group. Diagnosis often simple, with primary focus obvious.

DIAGNOSIS FROM: (1) *Typhoid fever*; (2) *Infective endocarditis*; (3) *Malaria*; (4) *Acute miliary tuberculosis*. Occasionally: Impacted gall-stones; pyelitis; Hodgkin's disease (Pel-Ebstein type); *B. abortus* infections.

Treatment of Septicæmia, Pyæmia, and Toxæmia.—

Prontosil: The group of synthetic compounds known as sulphanilamides or sulphonamides have been proved to be beneficial in streptococcal infections, e.g., puerperal. Research is proceeding. Surgical treatment if any indication present.

General treatment: Fluid freely; alcohol freely; fluid by intravenous, subcutaneous, or Murphy's drip method.

Antiserum: Use scarlet fever serum for a hæmolytic streptococcus.

Vaccines: Dangerous in septicæmia.

Blood transfusion.

CHAPTER III.

ERYSIPELAS.

A spreading streptococcal inflammation of the deeper layers of the skin, with local and constitutional symptoms.

Etiology.—Commonest in *spring months*. Is contagious, conveyable by third persons or by bedding, etc., of a patient. *Onset* may be: (1) *Idiopathic*, commonly on face; (2) In puerperium. Also after surgical operations; from slight abrasions.

Alcohol, nephritis, diabetes, and debility are predisposing factors. *Recurrence* is common (especially facial).

Bacteriology.—A streptococcus originally described as a special strain, *Str. erysipelatis* (Fehleisen, 1884): now held to differ from *Str. pyogenes* only in lower virulence. Note, however: (1) Erysipelas is transmitted as such from one patient to another; (2) Purulent streptococcal foci do not lead to erysipelas.

Morbid Anatomy.—*Streptococci* are present in the spreading edge, in the lymphatics of the skin and subcutaneous tissues.

Symptoms (facial erysipelas).—

ONSET.—Malaise, rigor, pyrexia. Commences over nose and cheeks or at local abrasion.

AGE.—Extremely important. Frequency and mortality are greatest between 1 and 5 years: period includes nearly 80 per cent of deaths. Over 10 years, frequency less and mortality lower. Not frequent under 6 months (inherited immunity).

INDIVIDUAL SUSCEPTIBILITY important (*see* SCHICK TEST, p. 39).

Modes of Infection.—Very contagious. Transmission usually occurs almost directly from one person to another—e.g., from kissing, by interchange of pencils, etc., at schools. Sources of infection:—

1. DIRECTLY FROM INDIVIDUAL with typical active diphtheria.
2. INFECTED ARTICLES.—Bacilli may live for months.
3. DIPHTHERIA CARRIERS.
4. SUBJECTS OF ATYPICAL DIPHTHERIA—e.g., mild tonsillitis. Severe attack may occur in infected individual.

In the following the human contact is not so direct:—

5. EPIDEMICS DUE TO MILK.—Established in several outbreaks. Cows may carry virulent diphtheria bacilli on their udders, though they are not found elsewhere; possibly an ulcer is infected by a human carrier. Occasionally diphtheria carriers may infect milk. (*Note.*—Non-pathogenic diphtheroid bacilli are often present in milk and cheese.)

6. ACCIDENTAL INFECTION FROM CULTURES.

No transmission takes place by water or by air.

One attack does not confer immunity.

Bacteriology.—*B. diphtheria* was discovered by Klebs in 1883, and isolated by Loeffler in 1884. Now entitled *Corynebacterium diphtheria*. Commonly known as Klebs-Loeffler bacillus.

MORPHOLOGICAL CHARACTERS.—A non-motile, non-sporing bacillus. Length and appearance very variable: varies from a short bacillus with rounded ends, to irregular forms with swollen 'clubbed' extremities; the latter 'involution' forms are common in cultures of more than forty-eight hours' growth. May stain uniformly, but more commonly shows 'beaded' appearance or irregular staining. The arrangement of the bacilli in films from cultures is often characteristic, the groups resembling 'Chinese letters', due to the organism bending lengthways before division. From tissues, bacilli are often single, unless numerous.

STAINS.—*Gram-positive*, but fairly easily decolorized. Better stained as routine by Loeffler's alkaline methylene blue, or by toluidin blue. Neisser's stains, the original Bismarck-brown or the cresoidin method, exhibit the granules better.

SPECIAL CHARACTERISTICS.—(1) Irregular staining; (2) Arrangement.

CULTURAL CHARACTERS.—Grows well on all ordinary media in subcultures. Initial cultures from tissues to be made on Loeffler's blood-serum. *Growth is rapid* at 37° C. Colonies may be visible in twelve hours: bacilli may be found in films after six to eight hours. Very resistant to drying.

DISTRIBUTION OF THE BACILLUS IN THE TISSUES.—

1. IN THE MEMBRANE.—Mainly in superficial portions and on surface. Bacilli do not penetrate below membrane.

Diphtheria—Bacteriology, *continued*.

2. IN OTHER SITES, especially mucous membranes.—Occasionally present in *rhinitis*, *conjunctivitis*, and, less commonly, *otitis media*; also in vulva. Rarely in wounds, and very rarely in ulcerative endocarditis.

INOCULATION INTO ANIMALS.—Subcutaneous inoculation into leg of guinea-pig with forty-eight-hour broth culture or suspension is used to test virulence of bacilli. *Result*: Death in thirty-six to seventy-two hours, with rapid loss of weight; great oedema at site of inoculation; *hæmorrhages into suprarenals* and serous membranes; bacilli at site of inoculation only.

TOXIN AND ANTITOXIN.—Toxins from cultures of the bacillus on inoculation cause symptoms of the disease except for absence of membrane. Death in diphtheria is due to action of toxin and not to extension of bacillus. Animals can be immunized to a high degree by injections of the toxin, and horses are thus used for production of diphtheria antitoxic serum.

GRAVIS AND MITIS STRAINS.—*Gravis* strain ferments starch; *mitis* strain does not. There is no proof that *gravis* strain is invariably associated with highly toxic symptoms.

Avirulent Diphtheria Bacilli and Diphtheroid Bacilli.—

DIFFICULTY OF DISTINGUISHING VIRULENT KLEBS-LOEFFLER BACILLUS.—Caused by:—

1. AVIRULENT STRAINS OF DIPHTHERIA BACILLI.—Strains are frequently isolated from the fauces, especially from contacts, which are avirulent to animals on inoculation (*see below*). These are also avirulent to human beings and never regain virulence. They are morphologically identical with virulent bacilli, and only distinguishable by animal inoculation.
2. VIRULENT DIPHTHERIA BACILLI PRESENT, BUT CLINICALLY ATYPICAL.—

The bacilli may be found in conditions with clinical appearance of simple tonsillitis or angina without membrane. Cardiac failure or peripheral neuritis may follow, or virulent symptoms occur in persons subsequently affected.

3. AVIRULENT BACILLI RESEMBLING KLEBS-LOEFFLER.—

Hoffmann's Bacillus or *Pseudo-diphtheria Bacillus*.—May be present in various anginal and tonsillitic conditions: possibly infective, but sequelæ of diphtheria are absent. Occurs in healthy throats.

B. Xerosis and Skin Diphtheroid Bacillus.—Frequently present on conjunctiva even in health (is not the cause of xerosis). Closely resembles Klebs-Loeffler bacillus. Similar organisms are frequent on skin and in wounds.

4. PRODUCTION OF MEMBRANES BY OTHER ORGANISMS.—

Membranous inflammations may be due to streptococci and other organisms. Streptococcal membranes are true membranes, and separate without leaving a bleeding surface.

HOFFMANN'S BACILLUS—CHARACTERISTICS.—Short, plump bacillus with round ends. Involution forms and polar staining and 'beading' absent. Arrangement in cultures as Klebs-Loeffler bacillus, but frequently more definitely parallel. Gram-positive. *Fatalities and complications* do not occur. *Is non-pathogenic to animals.* Is a separate organism, and not a modified diphtheria bacillus.

DIFFICULTIES ARISING FROM DIPHTHEROID ORGANISMS.—In great majority of cases, no doubt arises. Use Neisser's stain when in doubt. Difficulty is caused by short non-involuting form of Klebs-Loeffler bacillus, which closely resembles Hoffmann's, and may be but slightly virulent to animals.

Greatest difficulty is the urgent need for a rapid opinion. In general: (1) A bacillus isolated from an inflamed throat with the morphological and staining reactions of diphtheria should be accepted as true diphtheria. (2) A similar bacillus isolated from elsewhere in the body should not be accepted as diphtheria until virulence to animals proved. (3) Cases of Hoffmann's bacillus from the throat, in presence of symptoms, should be treated in same manner as a severe tonsillitis. When necessary it may be referred to as 'infective tonsillitis'.

Schick Test.—

THEORY OF TEST.—(1) Presence of $\frac{1}{50}$ unit of antitoxin per c.c. of blood gives immunity to diphtheria; often present in normal persons. (2) Such amount prevents any reaction after injection of $\frac{1}{50}$ M.L.D. of diphtheria toxin (minimal lethal dose kills a 250-gm. guinea-pig at end of 4 days).

TECHNIQUE.—Inject *intradermally*, not subcutaneously, 0.2 c.c. of a saline solution containing $\frac{1}{50}$ M.L.D. (obtainable fresh from Burroughs Wellcome & Co. and others). The flexor surface of the forearm is convenient. In opposite arm inject, as control, toxin heated to 75° C. for 10 minutes.

REACTIONS.—Best judged after 96 hours.

1. **POSITIVE.**—Sharply circumscribed area of redness, diameter $\frac{1}{2}$ to 1 in.; appears in 24 hours, maximum in 72 to 96 hours; duration 7 days, pigmentation up to 10 days.
2. **NEGATIVE.**
3. **PSEUDO-REACTION.**—Ascribed to proteins of toxin, but doubtful. Commonest in adults; commences at 5 to 10 years; rare at younger ages. A larger and less circumscribed area of brighter red, appearing in 18 to 24 hours, maximum in 20 to 30 hours, and fading in 3 days. Hence necessity of control.

4. COMBINED PSEUDO- AND POSITIVE REACTIONS.

Pseudo-reactions are distinguished specially by shorter duration.

RESULTS AT VARIOUS AGES.—Under 6 months, all negative (inherited antitoxin); from 6 months to 6 years, 50 to 70 per cent positive; percentage falls to 20 per cent in adults.

Diphtheria—Schick Test, *continued*.

INTERPRETATION OF RESULTS.—

- a. **NEGATIVE.**—Indicates immunity.
- b. **POSITIVE.**—Indicates susceptibility.
- c. **PSEUDO-REACTIONS.**—Negligible.

Active Immunization.—Original method was injection of mixture of toxin and antitoxin, latter being added to prevent toxic effects : serious reactions common : not now in use. Toxicity of toxin is now destroyed by incubation with formaldehyde, but still produces immunity : known as anatoxin or 'toxoid' and used as : (a) Toxoid antitoxin mixture (T.A.M.)—reactions rare ; (b) Formol toxoid (F.T.)—reactions common over age of 8 years, and hence unsuitable ; (c) Toxoid antitoxin floccules (T.A.F.), a suspension of precipitate formed by mixture of toxoid and antitoxin—no reactions (but expensive). *Method* : Three injections of 1 c.c. subcutaneously at intervals of 3 weeks (less efficient at intervals of one week).

ALUM-PRECIPITATED TOXOID (A.P.T.).—Addition to ordinary toxoid solution of aluminium potassium sulphate causes flocculent precipitate of toxoid, the non-specific-nitrogen remaining in and being siphoned off in the supernatant fluid : precipitate is highly potent for immunization.

MOLONEY'S 'TOXOID TEST'.—Severe reactions may occur with A.P.T. or F.T. : susceptible persons recognized by Moloney's test. *Method* : Intradermal injection of 0.2 c.c. formol toxoid (dilutions in use vary : about 1 in 50). Positive reaction : red flush as in Schick test. T.A.F. to be used for positives.

RESULTS.—Immunity develops in 6 weeks : in 90 to 95 per cent. Duration lengthy, at present uncertain. Schick test may be used as control.

Carriers.—Presence of diphtheria bacilli in fauces without clinical symptoms occurs in :—

1. **'CONVALESCENT CARRIERS'**, subsequent to an attack.—Bacilli nearly always virulent : isolation necessary ; usually become negative in 6 to 8 weeks.
2. **'CONTACTS'**.—Bacilli may be : (i) Avirulent ; (ii) Virulent. *See CONTACTS, below.*

Only those with virulent bacilli constitute 'chronic carriers'.

DISPOSAL OF CHRONIC CARRIERS.—Often causes difficulty. No legal necessity apparently (in Great Britain) for notification of healthy carriers, even with virulent bacilli, or removal to fever hospital. But practitioners obviously incur responsibility if treating such carriers lightly.

TREATMENT OF CHRONIC CARRIERS.—Correct any local disease in fauces or nose : tonsillectomy often but not always effective. Open-air life. All syringing and antiseptics useless. Immunization, active and passive, and vaccines have failed.

Contacts.—When an outbreak of diphtheria occurs, all contacts must be examined. Those with clinical symptoms or faucial changes are separated and isolated. For the remainder, disposal and

treatment depends on: (1) Examination of throat swabs; (2) Schick test; (3) Virulence or avirulence of bacilli.

SWAB POSITIVE.—Isolate. Divide into:—

a. **SCHICK-POSITIVE.**—Give antitoxin. Subsequent division into:—

i. *Bacilli Virulent.*—This group are frequently incubating diphtheria and develop symptoms.

ii. *Bacilli Avirulent.*—Further isolation unnecessary. Active immunization after passive has passed.

b. **SCHICK-NEGATIVE.**—Divide into:—

i. *Bacilli Virulent.*—Are 'chronic carriers'.

ii. *Bacilli Avirulent.*—No isolation or immunization necessary.

SWAB NEGATIVE.—No isolation. Divide into:—

a. **SCHICK-POSITIVE.**—Active immunization.

b. **SCHICK-NEGATIVE.**—Immunization unnecessary.

Passive Immunization.—Prophylactic injections of antitoxin should only be given for definite reason—e.g., surgeon after performing tracheotomy, contacts who are swab-positive and Schick-positive.

Note.—Immunity not longer than 3 to 4 weeks: hypersensitiveness results: active immunization interfered with.

Morbid Anatomy.—Characteristic change is membrane formation in upper air-passages. The membrane is produced by changes in the superficial layers of the tissues, and is thus a 'false membrane'. Its formation is due to action of toxins of the diphtheria bacilli.

DIPHTHERITIC MEMBRANE.—

COMMON SITES.—*Tonsils and neighbourhood, and larynx.* Also occurs on pharynx, trachea, epiglottis, nares. In fatal cases, often in accessory sinuses. Rarely, on conjunctiva.

MACROSCOPIC CHARACTERS.—

1. *Colour of membrane grayish-white; later may darken.*

2. *Adherent, and leaves bleeding surface on separation.* In later stages separates easily.

3. *Is superficial: only in rare cases extends deeply.*

Disappears by disintegration.

HISTOLOGY.—Membrane is formed by coagulative necrosis of epithelial cells, with exudation of fibrin and, in deeper layers, of polynuclear cells. Frequently the epithelial cells are shed early. *Tissues below membrane are but little affected. Diphtheria bacilli present mainly on surface and in superficial layers: do not penetrate deeply.*

FAUCIAL DIPHTHERIA.—Initial slight catarrh of fauces. Membrane formation commences usually at one spot, either on tonsils or at junction of uvula and tonsil, and spreads over tonsil, pillar of fauces, uvula, over soft palate, and often over pharynx; *is not confined to tonsil.*

LARYNGEAL DIPHTHERIA.—Membrane may include rima. Spreads upwards to epiglottis; downwards may extend even to bronchioles. Faucial membrane usually present.

Diphtheria—Morbid Anatomy, continued.

LYMPHATIC GLANDS.—*Enlarged in neck and under jaw*: in severe cases extreme. Mainly due to secondary streptococcic infection, and not rapidly affected by antitoxin.

HEART.—Myocardial changes important. Fatty degeneration often marked. Endocarditis, very rare.

PULMONARY LESIONS.—*Bronchitis and bronchopneumonia* common and fatal, especially in laryngeal type. Pneumococcus is commonest organism: Klebs-Loeffler bacillus rare. *Membrane* may extend down trachea to bronchi; rarely to bronchioles.

NERVOUS SYSTEM.—Parenchymatous degeneration of peripheral nerves, sensory and motor, in diphtheritic paralysis.

OTHER CHANGES, NOT CHARACTERISTIC.—

BLOOD.—Definite leucocytosis, and relative increase of polynuclear cells.

KIDNEY.—Fatty degeneration, and rarely nephritis.

LIVER AND SPLEEN.—Toxic changes.

Duration of Infectivity.—Isolate until: (a) Three consecutive negative swabs at intervals of 3 days; (b) No local lesion. Usually 4 to 6 weeks.

Quarantine Period.—Contacts: (a) With negative swabs and no symptoms—14 days; (b) With positive swabs—until negative, if bacilli proved virulent.

Symptoms.—

INCUBATION PERIOD.—Usually two to five days, most commonly two. Rarely, bacilli may lie latent for prolonged period before symptoms arise.

EARLY SYMPTOMS.—General malaise. Temperature about 101° ; rarely exceeds 103° . Slight hoarseness: sore throat often unnoticed in children. Face gray. May be convulsions in infants. Knee-jerks often absent. Trace of albumin very frequent.

CLINICAL TYPES.—(A) Faucial; (B) Laryngeal; (C) Nasal.

A. FAUCIAL DIPHTHERIA.—In children is a silent disease—little pain, complaint, or crying—symptoms being toxæmic.

Early Symptoms.—As above. Some difficulty in swallowing. Tonsils: general catarrh; membrane often commencing on first day. Glands in neck and under jaw tender and slightly enlarged on affected side.

Third Day.—*Membrane* (see MORBID ANATOMY, above) on tonsils, palate, and uvula: may fill aperture. Glands larger. Temperature is variable. General malaise and toxæmia. Pain as a rule only on swallowing.

Fourth to Fifth Day.—*Membrane* extensive. Glands large. Breath very heavy. Tongue furred. Urine reduced. Albumin almost constant.

Favourable Cases.—Subsequently membrane disintegrates. Signs disappear. Convalescence in seven to ten days. Constitutional symptoms generally definitely in proportion to extent of membrane.

Severe Cases.—Ashy face. *Pulse* feeble, rapid, or often slow—the latter very serious. Temperature may be high or low. Membrane usually extensive. Nasal discharge common. Vomiting. Albumin increases. Prostration marked. *Death* from cardiac failure: often sudden: usually in three to eight days. *Larynx* often involved.

Tonsils may show following variations: (1) Punctate exudate as in follicular tonsillitis; (2) General purulent exudate; (3) Miliary membrane at several points; (4) Catarrh. In severe cases with little membrane, virulent bacilli often numerous in nares.

B. LARYNGEAL DIPHTHERIA.—Commonest about three years of age. Nearly always secondary to faucial diphtheria, and faucial membrane, cervical glands, and symptoms present.

Early Stage.—An acute laryngitis producing 'croup', viz.: (1) Hoarseness; (2) Harsh cough; (3) Inspiratory stridor; (4) Inspiratory recession above clavicle.

Clinical Varieties.—

1. Onset sudden, but symptoms not severe. *Paroxysms of dyspnoea* for few hours, due to spasm of glottis. Membrane slight. Prognosis good.
2. Onset less sudden. Dyspnoea becomes continuously worse, without spasms. Colour livid. Cyanosis and 'croup' increase. Restlessness, vomiting, and coma. Condition associated with spread of membrane down trachea. Pulmonary complications common. Prognosis very bad.

Temperature rarely high unless faucial symptoms marked.

In adults, laryngeal diphtheria is rare, but is often overlooked; width of larynx prevents blockage, and hence there is no croup. Membrane spreads to fine bronchi, with severe symptoms and high mortality.

C. NASAL DIPHTHERIA.—Occurs in two forms:—

1. *Primary Membranous Rhinitis.*—Nasal discharge. Membrane often very extensive. Symptoms often slight, and cause overlooked.
2. *In Faucial Diphtheria.*—Discharge may be hæmorrhagic. Symptoms usually severe though membrane slight.

Complications.—

1. **PULMONARY.**—*Bronchitis and bronchopneumonia* nearly always present in severe cases.
2. **CARDIAC.**—*Irregularity* very common: faint murmur frequent. *Marked irregularity*, and especially slow pulse, of serious prognosis: often sudden death. Severe cardiac symptoms not common in acute stage. Blood-pressure falls very low.
3. **ALBUMINURIA.**—*Almost constant*, and *very early*, not uncommon on first day. Amount large in severe cases. Anuria serious. Subsequent nephritis very rare.
4. **VOMITING.**—Dangerous sign.

Diphtheria—Complications, continued.

5. RASHES.—Diffuse erythema occasionally even in absence of antitoxin.
6. LYMPHATIC GLANDS.—Periadenitis and cellulitis of neck may develop; occasionally suppuration; due to streptococci.
7. RELAPSES.—Marked in 1 per cent. Slight return of sore throat more common. Give further antitoxin.

Sequelæ.—Of extreme importance: (A) Paralysis; (B) Cardiac failure.

A. POST-DIPHTHERITIC PARALYSIS.—Strict sequel: occurs in second or third week of convalescence: of toxic origin.

FREQUENCY.—10 to 15 per cent: higher in adults. Most common in *faucial type*. Usually following severe cases, but also in mild forms.

EFFECTS OF ANTITOXIN TREATMENT (Goodall).—Total frequency not diminished, but paralysis of less severity: ascribed to survival of great numbers of severe cases. Paralysis rare when antitoxin given on first or second day.

PROGRESS.—From onset of paralysis takes two to seven weeks to become complete. Progress may be arrested at any stage.

ORDER OF PROGRESSION.—(1) Palate; (2) Eye; (3) Limbs; occasionally (4) Trunk; (5) Diaphragm; (6) Intercostals. *Special senses never affected.* Facial paralysis rare. Involvement of sphincters very rare.

1. *Palate.*—Nearly always affected first. Earliest signs: Nasal voice; regurgitation of food through the nose. On examination: Palate relaxed, motionless, insensitive, and reflex absent: changes often incomplete in milder degrees. Constrictor of pharynx affected in severe cases, whence difficulty in deglutition, and choking. Larynx affected in late stages with widespread paralysis: paralysis of adductors, causing hoarseness and weak cough: may simulate relapse of laryngeal diphtheria. Anæsthesia of larynx may lead to aspiration of food.

2. *Eye.*—Frequency of affection next to palate. Most common is loss of power of accommodation from paralysis of ciliary muscles, revealed by difficulty in reading. External rectus most commonly affected of extrinsic muscles. Diplopia and squint of every grade to complete ophthalmoplegia externa (very rare). Pupils often sluggish: may react to light and not to accommodation (very rare apart from diphtheria and encephalitis lethargica). Argyll Robertson pupil very rarely.

3. *Limbs.*—Legs more frequently affected than arms; commences with weakness in walking. Knee-jerk, and deep reflexes abolished. With complete paralysis, wasting of muscles is often extreme. Sensation is usually affected, but marked loss is unusual. Reaction of degeneration very rare.

4. *Trunk Muscles*.—May be inability to move head.
5. *Diaphragm*.—Special danger to lungs from accumulation of mucus.
6. *Intercostals*.—Respiration seriously affected.

A generalized type of paralysis occurs in which the last three groups of muscles are specially affected: otherwise their involvement is uncommon.

COMMON COMBINATIONS of paralyses are: (1) Palate only or ocular only. (2) Palate and slight ocular, especially accommodation. (3) Palate, slight ocular, knee-jerks absent, and some weakness of legs. These three forms are frequent; recovery is usual in two to three weeks. (4) Severe: palate, pharynx, eyes, and legs. (5) Generalized form: palate and eyes slight, trunk and limbs marked.

CAUSE OF DEATH IN PARALYSIS.—(1) *Respiratory failure* from paralysis of muscles; aspiration pneumonia; massive collapse of lungs. (2) *Cardiac failure*.

PROGNOSIS IN PARALYSIS.—When mild, recovery complete in a few weeks. Severe cases, prolonged. *Paralysis never persists with life*. Mortality in adults very low.

B. CARDIAC FAILURE.—Apart from acute stage, failure most common in third week. Cardiac symptoms may occur as follows:—

1. Patient with paralysis of any degree allowed to get up: may be suddenly fatal.
 2. Patient without paralysis allowed up under three weeks after severe attack.
 3. Rarely occurs in bed, after severe attack, on slight exertion. Slight symptom is tachycardia.
- Serious symptoms are severe precordial pain, vomiting, irregularity, and dilatation: mortality very high.

Diagnosis.—

1. BACTERIOLOGICAL METHODS.—Rub sterile swab on membrane or tonsil; inoculate blood-serum; incubate twelve hours at 37° C.; a preliminary examination may be made in eight hours. The swab is also rubbed directly on a microscope slide, and the smear stained and examined: positive results not uncommon, but negative results of little value. Presence of Klebs-Loeffler bacilli is absolute proof: absence in cultures, with definite membrane present, is negative proof. With suspected laryngeal diphtheria, repeat examination if negative.

A negative examination may result erroneously from: (a) Use of antiseptics on fauces: should not be employed for four hours previously. (b) Membrane not touched by swab. (c) Mixed infection: careful examination of film necessary.

Severity of attack cannot be judged from culture; but with pure cultures it is usually severe.

For difficulties of bacteriology, see BACTERIOLOGY.

Never wait for bacteriological report before commencing treatment.

2. CLINICAL DIAGNOSIS.—Early albuminuria and absence of knee-jerks are often suggestive.

Diphtheria—Clinical Diagnosis, continued.

- a. **FAUCIAL DIPHTHERIA.**—Diagnosis necessary from: (i) Follicular tonsillitis; (ii) Scarlet fever. Less commonly, from secondary syphilis, thrush fungus, quinsy, Vincent's angina, and herpes of palate. Scalds of pharynx and curds of milk have caused mistakes.

Follicular Tonsillitis.—Onset rapid. *Temperature* high, 104°. Face flushed. Any membrane present is limited to tonsils, and leaves no bleeding surface on separation.

Scarlet Fever.—Sudden onset with vomiting. *Temperature* high, 103°. *Pulse* rapid. Face flushed: circumoral pallor. *Tongue* strawberry. *Rash*: punctate erythema.

Quinsy.—Diphtheria never suppurates.

- b. **LARYNGEAL DIPHTHERIA.**—Diagnosis from: (i) Acute laryngitis; (ii) Measles; (iii) Retropharyngeal abscess; (iv) Bronchopneumonia. Less commonly from laryngismus stridulus, foreign body, and papilloma of larynx.

Acute Laryngitis.—Often difficult. Constitutional symptoms slight. Bacteriology. Primary acute laryngitis in infants is nearly always diphtheria.

Measles.—Catarrhal symptoms. Koplik's spots. No membrane present. Later, typical rash.

Retropharyngeal Abscess.—Recognized by position of head and by palpation.

Bronchopneumonia.—Expiratory stridor. Retraction of lower ribs.

Laryngismus Stridulus.—Recurrent nocturnal attacks of dyspnoea. Sudden onset. No membrane. Slight general symptoms. Spasm relieved by warm bath or by chloroform.

Papilloma of Larynx.—Hæmorrhage occurs.

Association with Other Specific Fevers.—Frequent with measles and scarlet fever (q.v.); prognosis serious.

Prognosis.—

INJECTION OF ANTITOXIN.—Prognosis varies almost directly with day of injection: mortality under 2 per cent when given on 1st or 2nd day: with recent larger doses is practically nil in faucial forms. Death-rate rises rapidly with delay, about 5 per cent when given on 3rd day, and 10 per cent when given on 4th day.

LARYNGEAL FORM.—Death-rate much higher than faucial form, but very low if injection given on 1st day.

AGE.—Mortality decreases rapidly after 7 years. The younger the age, the higher the mortality.

DANGEROUS SYMPTOMS.—Very irregular *pulse*, especially if slow. Low temperature with symptoms of prostration. Repeated vomiting. Marked albuminuria. Convulsions.

IN FAUCIAL DIPHTHERIA.—Extensive membrane. Great enlargement of glands.

IN LARYNGEAL DIPHTHERIA.—Marked obstruction. Pulmonary symptoms.

IN NASAL DIPHTHERIA.—Free hæmorrhage.

IN PARALYSIS.—Extensive paralysis. Involvement of respiratory muscles. Signs of cardiac weakness. Vomiting.

Prophylaxis.—The following measures should be adopted:—

Complete isolation of patient, disinfection of clothes, etc.

Patient not discharged until Klebs-Loeffler bacilli absent: three examinations at intervals of at least four days, preferably commencing on twenty-first day. (Many competent authorities consider these examinations unnecessary if patient be clinically free from all symptoms.)

Examination of contacts: see CONTACTS, p. 40.

All attendants should wear gowns and caps, and gauze masks over nose and mouth; pay special attention to sterilization of hands; gargle with weak carbolic lotion or antiseptics.

Treatment.—Methods of primary importance are: (1) Injection of antitoxin; (2) Rest. Of less importance are general hygiene diet, local treatment, treatment of special symptoms. *Note:* In presence of symptoms, commence treatment without waiting for bacteriological report.

1. INJECTION OF ANTITOXIN.—

DOSAGE.—Varies greatly with day of disease, and also with severity and clinical type, and less with age of patient. When in doubt, give a large dose. The general aim is to give all the antitoxin necessary within at most 24 hours, and not spread it over several days.

Seen 1st day of disease: Give 4000 to 8000 units, depending on age and severity: repeat in 12 hours. In laryngeal type, inject 6000 to 8000 units, repeat in 8 to 12 hours: when very severe, 10,000 units, and repeat twice within 24 hours. On 2nd day, repetition to be judged by condition; in faucial type, frequently unnecessary; in laryngeal type, advisable: single dose of amount as above. On subsequent days, depending on condition.

First seen after 1st day: Dosage increased by one-half for each day.

Children require a dose almost similar to adults: under 2 years, give two-thirds of above.

Desired result is general improvement and shrivelling of membrane, commencing in 12 to 24 hours.

METHOD OF ADMINISTRATION.—

Intramuscular injection into flank, etc., advisable as routine method: more effective than subcutaneous. Use carefully sterilized syringe and needle. Only freshly-opened phial of serum to be used.

Intravenous injection: In severe, late, and hæmorrhagic infections. Inject slowly, undiluted, at body temperature. Use concentrated serum. Give also intramuscular injection.

Diphtheria—Treatment—Injection of Antitoxin, *continued*.

AFTER-EFFECTS OF ANTITOXIN.—

a. *Serum Rash*.—Onset seven to fourteen days after injection—usually ten days. *Urticaria* or *erythema*: may closely resemble measles. *Bathe* with lead lotion: The irritation is so extreme that morphia is frequently necessary. Calcium lactate has no preventive effect. Pyrexia and joint pains not uncommon.

b. *Anaphylaxis or Hypersensitiveness*.—Occurs in those who have had previous serum injection more than ten days previously: may be many years. Symptoms may develop with great rapidity, especially with intravenous injections; if intramuscular, more commonly in half an hour to three hours; occasionally in one or more days. In acute cases, rapid onset of collapse. When less severe, shivering or rigor, dyspnoea, cyanosis, vomiting, varying degree of cardiac weakness and prostration, rash. Very rarely fatal except in asthmatics. *The possibility of anaphylaxis is never a contra-indication to intramuscular injections for curative purposes.*

Desensitization: If intravenous injections are considered essential, preliminary desensitization may be practised. Inject at intervals of five minutes successively 0.5 c.c., 1 c.c., 2 c.c., 5 c.c. of serum. If no symptoms occur, continue with complete dose. If symptoms occur, wait for half an hour before next injection, or give dose intramuscularly. Hypersensitiveness may be so extreme that dangerous symptoms occur with minute doses: in such cases intravenous injections must be abandoned.

Treatment of symptoms: Stimulants. Hot blankets. Adrenaline 1-1000, 1 to 2 c.c. (for adult) intramuscularly.

2. REST IN BED.—*Must be absolute, lying flat.*

DURATION.—In mild cases, for three weeks after membrane disappears. When severe, for at least three weeks after disappearance of symptoms, and period increased at slightest indication.

Each stage in getting up and convalescence should be extremely gradual, and pulse watched. Thus, for several days patients should be sitting up in bed. Risk of cardiac failure is present from onset, and persists into convalescence.

GENERAL HYGIENE.—Remove carpets, etc. Temperature of room 63°. Free ventilation. Air not too dry, especially in laryngeal type (use bronchitis kettle). Give calomel.

DIET.—Milk. Custard and semi-solids in older children. If vomiting, peptonize milk: stomach wash rarely possible.

LOCAL TREATMENT.—Aims at cleanliness. Does not kill bacilli: omit if causes struggling. Syringe fauces and nares (if discharge): use warm water or salt and water. If less severe,

swab with 1 per cent carbolic. For nasal form or septic discharge, syringing essential (listerine and borax); for profuse hæmorrhage, syringe with ice-water.

TREATMENT OF SPECIAL SYMPTOMS.—

COLLAPSE AND CARDIAC FAILURE.—Cardias stimulants.

PARALYSIS.—*Rest in bed*, absolute and prolonged. Give liberal diet, and arsenic and strychnine. *For severe regurgitation of food*: nasal tube in infants, stomach tube in adults. *Paralysis of respiratory muscles*: raise foot of bed; oxygen; if severe, artificial respiration in Drinker's apparatus. *Wasting of muscles*: massage, electricity.

LARYNGEAL OBSTRUCTION.—*Indications for tracheotomy*: increasing dyspnoea, inspiratory recession above clavicles, and restlessness. *Intubation* only in hospitals.

'DIPHTHERIA CARRIERS'.—See above, p. 40.

CHAPTER V.

THE PNEUMONIAS.

LOBAR PNEUMONIA.

(*Croupous Pneumonia.*)

An acute specific disease caused by the pneumococcus, and characterized by toxæmia, consolidation of the lungs, and a fever which usually ends by crisis.

ETIOLOGY.

FREQUENCY.—Accounts for 5 to 10 per cent of all deaths.

AGE.—Frequency increases to 6th year, falls to the 15th year, and then again increases, especially for later decades.

SEX.—Males 2 or 3 to 1 female: probably due to conditions of life. Incidence equal when in similar conditions, e.g., prisons.

GEOGRAPHICAL DISTRIBUTION.—Universal: somewhat less frequent in tropics.

RACE.—Negroes and coloured races have high incidence and mortality when placed under abnormal conditions.

EPIDEMICS.—Outbreaks may affect households, institutions, and wider areas. (Most of the recorded epidemics are insufficiently studied. The possibility of 'influenza' especially affects epidemics.)

Factors Increasing Liability to Attack.—

1. **SEASON.**—Incidence highest in winter and spring.

2. **OCCUPATION.**—Outdoor occupations show a higher incidence.

3. **PREVIOUS ATTACK.**—Frequently several attacks occur. One attack probably predisposes to a second.

4. **COLD.**—Pneumonia frequently follows exposure.

Lobar Pneumonia—Etiology, continued.

5. **DEBILITY** due to any cause.
 6. **ALCOHOL** is a specially important factor in prognosis.
 7. **OTHER DISEASES.**—Some diseases especially predispose to pneumonia, e.g., influenza, and chronic debilitating conditions.
 8. **TRAUMA.**—Attack may apparently follow directly upon injury, particularly of chest, not necessarily any lesion of the lung.
- As the pneumococcus is frequently present in the fauces of healthy persons, these factors are supposed to act by reducing the resistance of the body to its effects.

BACTERIOLOGY.**The Pneumococcus.—**

MORPHOLOGY.—Typically a lance-shaped coccus, occurring in pairs—i.e., a diplococcus. In body fluids has a *capsule* which is recognizable but unstained except by special methods: capsule lost in cultures. May occur in short chains of 4 to 8 cocci when grown in fluid media. *Gram-positive*. In body fluids is extracellular, phagocytosis not occurring. Cultures are necessary before the coccus can be identified with certainty.

CULTURAL CHARACTERS.—Most important are: Fine colonies on agar, no growth on gelatin, acidifies raffinose broth and inulin, usually *coagulates milk*. Thus differentiated from streptococci and staphylococci. Growth is very delicate, and cultures usually die out in a few days.

SYNONYMS: *Micrococcus lanceolatus*, *Diplococcus pneumoniae*.

Other Organisms present in Lobar Pneumonia.—*Str.* and *Staph. pyogenes*, Friedländer's pneumobacillus, *B. influenzae*, and rarely *B. diphtheriae*, *B. typhosus*, and other bacteria, may be associated with pneumococcus in lobar pneumonia.

B. Pneumoniae of Friedländer.—A short non-motile bacillus with rounded ends. In tissues often as a diplobacillus and with capsule. Gram-negative. Produces acid and gas in dextrose, lactose, mannite, and maltose. Belongs to the colon group of bacilli. Is never the cause of true lobar pneumonia, but may cause septicæmia.

Immunity. Specific Therapy. Prophylactic Inoculation.—Animals can be immunized by injections of pneumococci, attenuated by heat or other methods. Duration of immunity is a few weeks. Serum of immunized animals is protective to some extent against injections with pneumococci: also contains agglutinins.

STRAINS OF PNEUMOCOCCI.—The Rockefeller Institute, by agglutination experiments with sera prepared as above, separated four types. Relative frequency (open to revision): Type I, 30 per cent; mortality 25 per cent. Type II, 30 per cent; mortality 30 per cent. Type III, 20 per cent; mortality 45 per cent. Type IV, 20 per cent; mortality 10 per cent. Type III slightly differs culturally (*Pneumococcus mucosus*); is the most virulent, but rare. Type IV contains many strains, mostly of low virulence:

Cooper has separated 29. Type specificity is due to polysaccharides in the capsules of the organisms, these differing in chemical constitution.

PNEUMOCOCCIC ANTISERA.—Antisera have been prepared for Types I and II: a serum is only of use for its homologous type.

FELTON'S CONCENTRATED SERUM.—Prepared to contain antibodies to Type I and Type II. Initial dose for adults (intravenous): 20,000 units; repeat in 8 hours. Two doses on second and, if indicated, on third day. Serum warmed and injected slowly (10 c.c. per minute). Serum reactions often severe. Sputum to be typed as soon as possible. Results: Type I infections, mortality halved; Type II, no effect has been proved.

Concentrated Type I serum is available (cheaper than Felton's). Severe cases with positive blood-culture are unaffected.

For tests for hypersensitiveness *see* DIPHTHERIA.

TYPING OF PNEUMOCOCCI.—(1) Mouse test: washed sputum injected into peritoneal cavity: pneumococci in peritoneal exudate in 12 to 18 hours: agglutinate with type sera. (2) Neufeld's method: the various sera are added to sputum: homologous serum causes swelling of capsule of pneumococci: rapid, but difficult to assess.

PROPHYLACTIC INOCULATION.—Pneumonia is prevalent among natives employed in South African mines. The incidence and mortality are highest during the first weeks of employment. Lister finds that prevalent strains agree with Types I, II, and IV of the Rockefeller Institute, and has prepared a vaccine: dosage, three weekly injections, with total of 7000 million cocci. Considerable immunity results.

MORBID ANATOMY.

The changes of acute inflammation occur in the lung, but are so modified by the nature of the tissue as to be characteristic. Three stages are recognized: (1) Engorgement; (2) Red hepatization; (3) Gray hepatization; and also (4) Resolution.

Note.—X-ray examinations suggest that pneumonic process commences at hilum and extends outwards, reaching surface in 3 days: diaphragm early begins to rise.

1. Stage of Engorgement.—

MACROSCOPIC.—Lung deep red, firm, and more solid than normal. On section, surface red and moist. Air present and lung crepitates, but less than normal. Portions float in water.

HISTOLOGY.—Capillaries dilated and engorged. Alveoli contain some blood-corpuscles, alveolar cells, and serum. Alveolar epithelium swollen.

2. Stage of Red Hepatization.—

MACROSCOPIC.—Lung appears bulky, and feels heavy. Is firm and airless. Pleurisy present on surface. On section, surface is red-brown, dry, and granular (due to contents of alveoli). Distinctly friable. Does not crepitate. Sinks in water. On

Lobar Pneumonia—Morbid Anatomy, continued.

scraping surface, small amount of reddish exudate (containing numerous diplococci).

HISTOLOGY.—Alveolar spaces occupied by network of coagulated fibrin containing red and white blood-cells and occasional epithelial cells. Alveolar walls infiltrated, and some leucocytes present in interlobular tissues.

3. Stage of Gray Hepatization.—

MACROSCOPIC.—*Colour gray.* On section surface moister and granules indistinct. Extremely friable. Does not crepitate. Sinks in water.

HISTOLOGY.—Alveolar spaces filled with leucocytes (in preparations, the plug is often retracted from the wall). Fibrin and red cells have been removed by phagocytic action of leucocytes. In extreme cases, this stage is sometimes called 'purulent infiltration'. Surface of cut lung covered with a purulent fluid.

4. Resolution.—Proteolytic enzymes digest and liquefy the alveolar contents, and the product is mainly absorbed and excreted by the kidneys. Some leucocytes are ejected in the sputum.

Distribution of Lesions in the Lungs.—(1) One lung alone is commoner than both. (2) Right lung is commoner than left. (3) Base is commoner than apex; commences at base in 75 per cent. (4) When both lungs affected, is usually both bases; both apices is rarest combination; the middle lobe is very rarely affected alone. (5) Several lobes may be affected simultaneously, or, more frequently, in succession, various stages being present at same time. (6) Apical pneumonia is commoner in children than adults; under five years, apices only in 30 per cent. (7) Central pneumonia, commencing at root, is rare (and doubtful).

STATISTICS: (1) Right lung only, 55 per cent; left only, 25 per cent; both 20 per cent. (2) One lobe, 40 per cent; two lobes, 40 per cent; more than two, 20 per cent.

WEIGHT of consolidated lung about 50 ounces (normal about 20 ounces).

AREA OF LUNG NOT CONSOLIDATED.—Rarely normal.

Usually congested and œdematous. The unaffected lung is usually congested: compensatory emphysema common.

PLEURA.—Inflammatory changes invariably present where pneumonic process has reached surface.

BRONCHI.—Contain froth; rarely the thick mucus of pneumonic sputum.

BRONCHIAL GLANDS.—Swollen; suppuration extremely rare.

Lesions in Other Organs.—Not common.

HEART.—Often contains firm coagula, especially on right side.

PERICARDITIS.—Commonest cardiac lesion (*see* COMPLICATIONS).

ENDOCARDITIS.—Rare, usually ulcerative. Pneumonia is a frequent antecedent in deaths from ulcerative endocarditis.

Less important changes are slight enlargement of the spleen and changes in the kidneys.

Rare occurrences are meningitis and colitis.

SYMPTOMS.

Incubation Period.—Unknown. Probably few hours to few days.

General Description.—

ONSET.—Abrupt, with rigor. *Temperature* has already risen during chill. General sensations of a severe febrile attack.

PRESENT FROM ONSET OR DEVELOPING RAPIDLY.—

- (1) Pain in the side, often very severe; (2) Short dry cough; (3) Rapid respiration.

DISEASE FULLY DEVELOPED.—Within twenty-four to forty-eight hours, condition characteristic:—

1. **FACE** flushed and eyes bright. Expression anxious.
2. **RESPIRATION.**—Short and rapid, frequently an *expiratory* grunt, or pause after expiration. *Alæ nasi* dilate.
3. **COUGH.**—Short, frequent, and repressed. Increases pain in side.
4. **EXPECTORATION.**—Very tenacious and blood-stained ('rusty sputum').
5. **SKIN.**—Dry and pungent.
6. **PULSE.**—Full and bounding. Pulse-respiration ratio often 2 to 1.
7. **LABIAL HERPES.**—Common.
8. **TEMPERATURE.**—High: 104° common.
9. **PHYSICAL SIGNS IN LUNGS.**

TERMINATION.—In typical cases by crisis, after five to ten days. Rapid convalescence.

Special Features.—

1. **VARIETIES OF ONSET.**—May be less abrupt than usual: patient may remain at work until lung is solid. Onset tends to be more insidious in elderly or debilitated persons, and in terminal pneumonia.

More than one rigor is rare—only in severe attacks.

2. **THE FEVER.**—

a. **PERIOD OF RISING TEMPERATURE.**—*Initial rise* very rapid: frequently reaches 102° to 104° F. in a few hours. Rise above 104° at onset not necessarily serious: possibly is evidence of healthy reaction. *Variations in rise of temperature* occur in children; in absence of a chill, rise is often more gradual; in drunkards, and in weakly and old people, temperature does not rise so high or so rapidly—prognosis bad; also when pneumonia occurs as a complication in other diseases.

b. **PERIOD OF CONTINUED TEMPERATURE (FASTIGIUM).**—*Temperature usually very constant*: variations often do not exceed 2° . Continuous high temperature, over 104° , is severe but not necessarily serious; in fatal cases may rise further or fall suddenly before death. Lower temperatures may be mild cases or due to poor reaction of system. Slow gradual fall from high temperature at onset is often serious.

c. **PERIOD OF FALLING TEMPERATURE.**—The temperature falls either *by crisis* or *by lysis*. If defervescence occupies longer than thirty-six hours, it is considered as lysis.

Lobar Pneumonia—Symptoms—Special Features, *continued*.

Crisis.—Temperature falls abruptly. Occurs most commonly between 5th and 10th days, especially on 7th. Rare after 12th, and not before 3rd day. Complete before 9th day in 90 per cent. *Fall* occupies 6 to 12 hours : 24 hours is a protracted crisis. Crisis probably marks stage of active immunity to toxins of pneumococcus : no evidence of occurrence of phagocytosis. *Profuse sweating* frequently precedes fall of temperature ; patient then falls asleep ; on waking, temperature, dyspnoea, general symptoms, and distress have abated without corresponding changes in physical signs. *Temperature curve at time of crisis* may show one or more of the following stages : (i) Pseudo-crisis : temperature falls nearly to normal and rises again : crisis follows, usually in 24 to 48 hours. (ii) Pre-critical rise : rises slightly shortly before crisis. (iii) Crisis : often falls to subnormal. (iv) Post-critical rise : rises slightly next day.

Lysis.—Temperature falls more gradually. More common in children (in 30 per cent of cases) than in adults. Usual form after 12th day of fever. In cases of delayed resolution, fever may persist many weeks.

3. **PAIN.**—Early symptom, rarely absent ; often extremely severe ; worse on coughing and deep inspiration.

CAUSE.—Due to involvement of pleura—therefore absent in central pneumonia, slight in apical, and most severe when the diaphragmatic pleura is affected.

NATURE OF THE PAIN.—

- a. **Local Pain.**—Almost invariable. Over area of affected pleura : deep tenderness on pressure : no superficial tenderness.
 - b. **Referred Pain.**—Not uncommon. If the inflammation affects the intercostal trunks, pain is referred to their terminal distribution ; hence pain is felt *in abdomen or iliac fossa*. Superficial tenderness absent.
 - c. **Reflected pain** from the lung. Pathological changes in lung render nerve end-organs incapable of stimulation ; hence reflected visceral pain is extremely rare. When it occurs, pain and superficial tenderness are present and may be on opposite side to affected lung.
4. **DYSPNOEA.**—Practically constant, from onset.

RATE OF RESPIRATION.—In adults : usually 40 to 50 when condition developed : at onset about 30. In children : 55 to 60—over 70 bad prognosis.

CHARACTER OF RESPIRATION.—Shallow and restrained. *Expiratory grunt* frequent. Inverted rhythm not uncommon in young children.

COURSE.—Marked increase during febrile period usually means bad prognosis. *At crisis*, rate falls, but more slowly than pulse and temperature : often several days before reaching normal.

- CAUSE.—Many factors are present: (a) *Toxæmia* is the main cause; (b) *Pain* causes shallow, and therefore rapid, respirations, of jerky character; (c) *Fever* is of little importance; (d) *Consolidation of lung* is of some importance, but degree of dyspnœa is largely independent of amount of consolidation.
- PULSE-RESPIRATION RATIO (normally 4 : 1). Lower than in any other condition; often 2 : 1; in children may be 1 : 1.
- CYANOSIS.—Slight degree common: in toxæmia lividity marked. Extreme cyanosis may develop in severe conditions, but, in general, cyanosis is less prominent than in bronchopneumonia.
5. COUGH.—An early symptom—onset usually with the pain. Typically: short, restrained, and frequent. Pain and distress often extreme. Disappearance of cough with signs of secretion in bronchi is a serious symptom. Often absent in old and young people and drunkards, and in terminal pneumonia. After crisis, becomes looser and less distressing.
6. SPUTUM.—At onset may be clear and mucoid: *very tenacious and of small amount* throughout.
- 'RUSTY SPUTUM'.—Usually present within two days. Occurs in more than half the cases. *Extremely tenacious*. No air-bubbles. Does not mix with saliva or pus. *Amount small*, one or two ounces a day. Colour due to blood, and gradually disappears. After crisis, sputum becomes looser, and often more profuse.
- IN CHILDREN (occasionally up to eleven years of age), often no expectoration owing to swallowing of sputum; occasionally rusty sputum is vomited. In old people also there may be no sputum.
- HÆMOPTYSIS.—Occasionally brisk at onset: usually several ounces. Is not of bad prognosis, and not necessarily due to tuberculosis or cardiac disease.
- COMPLICATIONS, e.g., bronchitis or œdema of lung, may alter character of sputum.
- MICROSCOPICAL CHARACTERS.—Leucocytes, red cells, mucus, epithelial cells, and various micro-organisms. May be fibrinous plugs of smallest bronchioles. Chemically: rich in *calcium chloride*.
7. POSTURE.—Varies. Patient usually lies on affected side.

PHYSICAL SIGNS IN THE LUNGS.

INSPECTION.—Movements of affected part are deficient; site often obvious when lesion extensive. When lower lobe affected, apex may move more freely than normal. Movement of healthy lung increased. Visible cardiac pulsation may be increased when left upper lobe is affected.

Note also rate of respiration, and action of accessory muscles of respiration.

PALPATION.—Lack of expansion of affected site. *Vocal fremitus* increased unless bronchi filled with secretion. (Patient should cough before test.)

Lobar Pneumonia—Physical Signs in the Lungs, *continued*.

Percussion and auscultation vary greatly in the different stages :—

Stage of Engorgement.—

PERCUSSION.—Little change, or note high-pitched and tympanitic, and by comparison may appear dull.

AUSCULTATION.—(1) Breath-sounds weak (often the earliest physical sign); (2) Fine 'crepitant râles'.

The 'crepitant râles' appear close to ear, occur towards end of respiration, often only on deep breathing, but not removed by coughing: probably due to separation of walls of alveoli stuck together lightly by exudation, but possibly are of pleural origin. The breath-sounds, rarely, are harsher on affected side.

Stage of Hepatization (Consolidation).—

PERCUSSION.—Note dull. Quality and degree vary considerably. Resistance to finger and woody dullness of fluid not present.

AUSCULTATION.—(1) Tubular breathing. Bronchial breathing commences with low pitch during expiration: as consolidation develops, rapidly increases to characteristic 'tubular breathing', *intense high-pitched, continuous* throughout inspiration and expiration, *with complete absence of adventitious sounds*. (2) Bronchophony, viz., vocal resonance greatly increased. No adventitious sounds present during height of stage.

Stage of Resolution.—Physical signs commence to change usually within twenty-four hours of crisis.

PERCUSSION.—Note gradually returns to normal.

AUSCULTATION.—Tubular breathing gradually disappears. May be 'redux crepitations', but often absent. Lungs return to normal in four to seven days: in children sooner. When consolidation has been extensive, percussion note for several weeks may remain abnormal, slightly dull or tympanitic. When temperature falls by lysis, resolution is usually slower. Occasionally consolidation appears to spread after crisis. Possibly crisis marks a general immunity, but a local immunity does not occur simultaneously.

Physical Signs in Unaffected Lobes or Lung.—(1) Movement increased; (2) Percussion note hyper-resonant; (3) Breath-sounds loud and puerile in character; (4) No moist sounds unless bronchitis or congestion is present. (The lesion is occasionally diagnosed on the wrong side in the early stages.)

Central Pneumonia.—Occasionally symptoms are typical, but physical signs are absent or develop later. Explanation may be: (i) Central pneumonia commencing near root. *Never found post mortem*, but is suggested by radiographs. (ii) Symptoms due to pneumococcal septicæmia, and lungs involved later: probable explanation.

CHANGES IN OTHER SYSTEMS.**Circulatory System.—**

PULSE.—*Full and bounding*. Rate increased in proportion to pyrexia, 100 to 120. Not dicrotic. *Variations of pulse without*

cardiac failure ; children faster than adults, 120 to 160 ; healthy young adults often under 100 ; in old and feeble persons, small and rapid from onset ; with extensive consolidation, may be small and running. Even in serious cases pulse may be full and deceptive in prognosis. After crisis, rapidly becomes normal. Bradycardia occasionally during convalescence ; is of no significance.

HEART SOUNDS.—Usual variations from normal are : (1) Sounds loud and clear ; (2) Pulmonary second sound accentuated ; (3) Mitral and pulmonary murmurs not uncommon during fever, especially in children.

FAILURE OF THE HEART.—The possibility is a constant anxiety. *Early physical signs* of failure : disappearance of accentuated pulmonary second sound ; dilatation of right side of heart ; sounds develop foetal rhythm. Pulse-rate usually increases. *Symptoms* : Increasing cyanosis, orthopnoea, and diminution of urine. *Collapse with rapid feeble pulse* may occur early : not always fatal. Rapid cardiac failure with toxæmic symptoms may occur suddenly and fatally, in healthy people : very rare.

ENDOCARDITIS AND PERICARDITIS.—(See COMPLICATIONS.)

BLOOD-PRESSURE.—No constant variation : often unchanged throughout attack and crisis. Gradual fall of more than 20 mm. Hg suggests cardiac failure. Prognosis serious if pulse-rate per minute exceeds blood-pressure in mm. of Hg.

BLOOD.—*Leucocytosis* appears early : number 12,000 to 25,000 per c.mm., rarely exceeds 30,000 per c.mm. Polynuclear cells : increase in percentage. Returns gradually to normal after crisis.

Prognosis is most favourable with moderate leucocytosis (about 15,000 per c.mm.). Serious in absence of leucocytosis. Anæmia is unusual.

Skin.—*Hot and pungent*. Important changes are : (1) *Herpes* : more common than in any other fever : in 25 per cent of cases. Site : around mouth and nose ; very rarely elsewhere. Prognosis favourable when present. Cause unknown. Pneumococci said to have been isolated from vesicles. (2) *Sweats* : profuse at crisis, often slightly precede fall of temperature. Not common during fever. Subsequent to crisis suggest suppuration (empyema).

Digestive System.—No change distinctive from other fevers.

TONGUE.—Commonly white and furred. Dry in toxæmia.

APPETITE.—Lost early. Recovers rapidly after crisis.

VOMITING.—Rare except in children.

BOWELS.—Usually constipated : may act normally. Diarrhœa rare. Meteorism : occasionally severe.

SPLEEN.—Not uncommonly enlarged (examination difficult owing to pain on deep respiration).

Urine.—Usual febrile characters present. *Trace of albumin* common. Albumose in severe cases. *Excretion of chlorides markedly diminished* : true retention occurs, retained sodium chloride being excreted after crisis ; no apparent value in prognosis. Uric acid rises about crisis (due to absorption of exudate or leucocytosis). Acute nephritis rare.

Lobar Pneumonia—Systemic Changes, *continued*.

Nervous System.—Most frequent symptoms are :—

1. HEADACHE.—Occurs in 50 per cent. Rarely severe.
2. INSOMNIA.—Frequent, *often severe and extremely troublesome to treat*. Aggravated by, but may be entirely independent of, pain, cough, or dyspnoea.
3. DELIRIUM AND PSYCHICAL DISTURBANCES.—Slight degrees of mental dullness rarely absent in typical forms. With severe delirium and psychical disturbances, prognosis is serious. Occurs in : (a) Toxic cases. (b) Delirium tremens in alcoholic patients. Very common. (c) Onset with acute mania (rare). (d) Onset in children simulating meningitis; prognosis is not serious.

Apical pneumonia is more liable to nervous symptoms. Cerebral symptoms occasionally occur after crisis. Recovery in all forms is rapidly complete when not fatal.

4. CONVULSIONS IN CHILDREN.—May occur : (a) At onset in place of rigor; (b) Repeatedly at onset in cases simulating meningitis; (c) Later in attack at commencement of true meningitis (rare).

COMPLICATIONS.

Complications are few in number, but account for a considerable percentage of fatalities. The most important are : (1) *Pleurisy and empyema*; (2) *Pericarditis*; (3) *Endocarditis*; (4) *Meningitis*.

Bronchitis in some degree is almost constant, and is part of the disease.

1. Pleurisy and Empyema.—

PLEURISY is practically a part of the disease : inevitable when inflammation reaches surface of lung. Thickened pleura, sufficient to give signs, very rarely follows pneumonia (and is not usual explanation of persistent impaired resonance).

EMPYEMA is most common complication : about 4 per cent of cases. Commoner in children : about 12 per cent, and in 30 per cent of fatal cases.

BACTERIOLOGY.—Pneumococcus commonest, and best prognosis. Streptococcus not infrequent, especially in adults. Staphylococcus and other organisms very rare.

ONSET AND SYMPTOMS.—(i) Temperature rises again one to four days after subsidence; (ii) Sweats; (iii) General malaise, cough may return; (iv) Leucocytosis. Pain, dyspnoea, and rigors are unusual. Temperature may not fall to normal, but commences to rise again during lysis.

PHYSICAL SIGNS.—Those of pleural effusion. Vary with amount of fluid, which may be small.

Interlobar or diaphragmatic empyema is *very rare*.

2. **Pericarditis.**—In about 1 per cent : in more than 10 per cent of fatal cases (statistics vary greatly). Mortality at least 80 per cent in diagnosed cases. Often insidious and undiagnosed, hence frequency in recoveries cannot be estimated. *Amount of fluid*

rarely exceeds a few ounces. More common with right than left pneumonia: origin probably septicæmic, but may be direct extension. Pleurisy almost always present. Occurs usually in types otherwise severe. Physical signs of pericarditis, but obscured by pleural friction and pulmonary signs.

3. **Endocarditis.**—Rare. Is practically always ulcerative. Commoner in women. Specially affects hearts with previous valvular trouble. Aortic valve commonest, but right side more often affected than in other forms of endocarditis.

MENINGITIS is common termination.

4. **Meningitis.**—Rare, but always fatal. See MENINGITIS.

Other Complications.—

1. **PULMONARY COMPLICATIONS** include abscess and gangrene of lung, considered under MODES OF TERMINATION (p. 61).

2. **COMPLICATIONS RESULTING FROM PNEUMOCOCCAL SEPTICÆMIA.**—Commoner in children. Onset usually a few days after temperature becomes normal or during fall by lysis. Meningitis certainly, and probably pericarditis and endocarditis, described above, really belong to this group.

a. **OTITIS MEDIA.**—Not uncommon in children: in 3 per cent of cases. No special characteristics.

b. **ARTHRITIS.**—Mainly in children. May precede onset of pneumonia. Larger joints affected; hot painful swelling; in mild cases may subside, in severe cases suppuration may occur. Mortality very high in latter, probably from associated septicæmia.

c. **JAUNDICE.**—Slight icteroid tinge not uncommon, but definite jaundice rare. Cause doubtful. Usually slight, begins during pyrexia, and prognosis good. In toxæmic cases, mortality high.

d. **PERITONITIS.**—Very rare. Onset follows defervescence. Mortality very high. (See PERITONITIS.)

e. **NEPHRITIS.**—Rare.

3. **VARIOUS AND RARE COMPLICATIONS.**—

THROMBOSIS.—Occurs rarely in peripheral veins, usually femoral. Ante-mortem clots in the heart are very rare.

EPISTAXIS.—May occur at onset (about 3 per cent).

COLITIS.—In severe cases.

Appendicitis may coexist, but relationship is doubtful.

Peripheral neuritis, aphasia, parotitis, and numerous other complications occasionally recorded.

RELAPSES AND RECURRENCES, CONVALESCENCE.

Relapse.—Different lobes may be successively involved (creeping pneumonia). True relapse after crisis is extremely rare; initial attack usually abortive.

Recurrence.—Very common in pneumonia—immunity due to attack is of short duration.

Convalescence.—Generally rapid and uninterrupted. Sequelæ rare.

Lobar Pneumonia, *continued*.

CLINICAL VARIETIES.

Anatomical Varieties.—(See DISTRIBUTION IN LUNGS, p. 52.)

APICAL PNEUMONIA.—Commoner in children: said to be frequently associated with cerebral symptoms.

CREEPING PNEUMONIA.—Involving successive lobes.

DOUBLE PNEUMONIA.—Affecting both lungs simultaneously, usually bases. In latter, case mortality high.

CENTRAL PNEUMONIA.

MASSIVE PNEUMONIA.—The bronchi as well as alveoli are filled with exudate. Extremely rare. Physical signs resemble effusion.

Varieties Associated with Age.—

PNEUMONIA IN CHILDREN.—Main variations from adult type are: *Rigor rare*, onset frequently with convulsion. *Sputum absent*, is swallowed. *Apex* not uncommonly affected: 30 per cent of cases. Cerebral symptoms frequent. *Empyema* commoner than in adults. *Septicæmic complications* commoner. General mortality very low: about age of 3 years, death is very rare.

PNEUMONIA IN THE AGED.—Onset, symptoms, and physical signs all indefinite. Prostration marked and mortality high.

Other Varieties.

—The following varieties may also be considered:—

ALCOHOLIC SUBJECTS.—Pneumonia common: delirium tremens usually develops. Manifestations of pneumonia often indefinite. Mortality high.

TERMINAL PNEUMONIA.—Pneumonia may be the terminal condition in chronic diseases such as diabetes, heart disease, nephritis, or phthisis. Symptoms and physical signs are slight.

SECONDARY OR INTERCURRENT PNEUMONIA.—Not uncommon in certain specific fevers, e.g., typhoid fever. Symptoms indefinite. Physical signs slight. Bases usually affected. Histologically may be lobular pneumonia.

EPIDEMIC PNEUMONIA.—Definite epidemics occur: generally marked by special features and high mortality. Organisms other than pneumococcus may be the cause, e.g., plague bacillus. Certain of these epidemics are related to influenza.

LARVAL OR ABORTIVE PNEUMONIA.—Mild cases or with very short duration.

ASTHENIC OR TOXIC PNEUMONIA.—Local lesions slight. Prominent symptoms are suggestive of septicæmia, viz., prostration, marked nervous and toxæmic condition, jaundice, gastrointestinal symptoms. Probably is pneumococcal septicæmia: pneumococci often isolated from blood.

POST-OPERATIVE PNEUMONIA (see also POST-OPERATIVE PULMONARY EMBOLISM).—Frequency much reduced by: (1) Use of ether by open method; (2) Improved surgical technique; (3) More rapid preparation of skin by iodine, etc. Symptoms indefinite. Physical signs of low pneumonia: impaired resonance, feeble breath-sounds, crepitations. Post-operative consolidation of the lungs is not always a true lobar pneumonia, but may be:—

1. **INHALATION OR ANÆSTHESIA PNEUMONIA.**—Probably caused by aspiration of saliva, etc. Cooling of lungs by vapour of less importance.
2. **HYPOSTATIC PNEUMONIA.**—Influenced by recumbent posture, feeble circulation, and interference with diaphragm. Commoner after abdominal operations.
3. **MASSIVE COLLAPSE OF THE LUNGS.**
4. **PULMONARY EMBOLUS AND THROMBOSIS.**

Association of Pneumonia with other Diseases.—

1. **TUBERCULOSIS.**—Phthisis often terminates with a lobar pneumonia. Onset of acute tuberculous pneumonia may simulate lobar pneumonia. Lobar pneumonia never terminates in tuberculosis: cases where this appears to occur have been tuberculous from onset. There is no evidence that lobar pneumonia predisposes to tuberculosis.
2. **INFLUENZA.**—See INFLUENZA, p. 77.
3. **TYPHOID FEVER.**—Pneumonia may occur at onset or in third week of typhoid fever. (See p. 15.)
4. **INFECTIOUS DISEASES.**—Scarlet fever: pneumonia rare, but mortality high. Measles, whooping-cough, typhoid, etc.
5. **EMPHYSEMA AND CHRONIC BRONCHITIS.**—Increase severity of attack and prognosis of lobar pneumonia: death occurs in two or more weeks.
6. **MALARIA.**—May coexist with pneumonia, and symptoms of both become confused. Otherwise diseases are independent.

MODES OF TERMINATION.

Pneumonia may terminate as follows: (1) *Resolution*; (2) *Delayed resolution*; (3) *Organization and fibrosis—chronic interstitial pneumonia*; (4) *Abscess*; (5) *Gangrene*.

1. **RESOLUTION.**—Of cases which recover, 90 per cent terminate by normal resolution: 60 per cent after crisis, and 30 per cent after lysis. Lung usually normal within two weeks, frequently seven to ten days. The exudate in the alveoli mainly removed by liquefaction and absorption by the blood: some plugs may be coughed away. Resolution occasionally, but rarely, occurs without sputum.
2. **DELAYED RESOLUTION.**—About 4 per cent of all cases. Lower lobe usually involved, especially right. *Duration*: Rarely exceeds six weeks.

CLINICAL COURSE.—Crisis or lysis occurs, but temperature usually does not entirely subside. Physical signs of consolidation persist, usually over small area. After varying period, resolution occurs, generally slowly. Organization may follow. Pleural effusion must be excluded, and sputum examined for tuberculosis. Condition is not confined to debilitated persons, but in these and drunkards may be fatal.

Cause: probably failure of autolytic action of body fluids. Leucocytosis is absent.

Lobar Pneumonia—Modes of Termination, *continued*.

3. **CHRONIC INTERSTITIAL PNEUMONIA.**—Very rare. The exudate organizes, resulting in fibrosis of the lung or chronic interstitial pneumonia (q.v.). Delayed resolution precedes the fibrosis.
- ABSCESS.**—Rare termination. Mortality high. Onset is insidious. *Symptoms severe:* intermittent or remittent pyrexia, cough often severe and paroxysmal, sputum contains pus and elastic tissue, and becomes offensive. Signs of consolidation or excavation. (*See ABSCESS OF LUNG.*)
5. **GANGRENE.**—Extremely rare. Practically always fatal. Often with abscess. Sputum unbearably foetid: usually renders diagnosis certain. Abscess and gangrene occur most frequently with *diabetes*.

DIAGNOSIS.

Usually simple. In the first stage, symptoms may be practically conclusive before physical signs admit of localization. Difficulties in diagnosis arise from: (1) *Conditions in which the onset and nature of the attack are modified*; (2) *Conditions in which confusion with other diseases occurs*.

1. **Onset and Nature of Attack Modified.**—In terminal, secondary, intercurrent pneumonia in other diseases, and pneumonia in the aged. The condition is a 'low' pneumonia, viz., indefinite onset with physical signs not very marked. Condition is more frequently overlooked in these circumstances than an erroneous diagnosis made. Its onset is suggested by *rising temperature and cough*, and signs in lungs on examination.

IN CHILDREN.—Difficulty especially arises from:—

- a. **CEREBRAL SYMPTOMS IN PNEUMONIA.**
- b. **PLEURISY WITH EFFUSION SIMULATING PNEUMONIA.**—In children, vocal fremitus and tubular breathing may be present. Diagnosis mainly by hypodermic needle.
- c. **VARIOUS EXANTHEMATA.**—Convulsion and general condition at onset may be similar.
- d. **CONFLUENT BRONCHOPNEUMONIA.**
- e. **APPENDICITIS AND ACUTE ABDOMINAL CONDITIONS.**

IN ALCOHOLIC SUBJECTS.—Obscured by delirium tremens.

2. **Confusion with other Diseases.**—This occurs in:—

- a. **ACUTE ABDOMINAL DISEASES.**—When the pleuritic pain in pneumonia is referred to the abdomen, the abdominal wall becomes rigid and tender. Condition at onset may simulate almost any acute abdominal lesion. Diagnosis important, as operation may be suggested. Difficulties most often with:—

APPENDICITIS.—Diagnosis: limitation of movement of chest, pulse-respiration ratio, and early signs of pneumonia. This difficulty is especially frequent in children, owing to vomiting in pneumonia.

PERFORATED GASTRIC ULCER.

- b. **ACUTE PNEUMONIC PHTHISIS.**—Diagnosis at onset often impossible. Defervescence does not occur or is not complete;

pyrexia becomes irregular; wasting; consolidation persists. Later, tubercle bacilli in sputum. Fatal in two weeks or upwards. Suspect when temperature persists after twelfth day, but remember is *very rare*.

c. **TYPHOID FEVER.**—Difficulties may arise from: (a) 'Typhoid state' developing in toxic pneumonia; (b) Pneumonia occurring as complication in typhoid fever at onset or in third week. Diagnosis often depends on distinctive proofs of typhoid fever, i.e., rash and agglutination reaction. (The spleen is frequently enlarged in pneumonia.)

d. **INFLUENZA.**

e. **ABNORMAL FORMS OF LOBAR PNEUMONIA.**—If several cases occur in same household and *all are rapidly fatal*, possibility of plague must be considered.

Specific Methods of Diagnosis.—

1. **BLOOD CULTURE.**—Positive in early stages in 30 per cent: prognosis serious.
2. **X RAYS.**
3. **SPUTUM EXAMINATION.**

PROGNOSIS.

General Mortality.—The mortality of all cases at all ages is from 20 to 25 per cent. In private practice considerably less than in hospitals. The prognosis varies greatly in different circumstances, depending mainly upon: (1) *Age*; (2) *Previous habits and conditions of health*; (3) *Features of the attack*.

1. **AGE.**—Under 2 years mortality is high but the disease is rare. Between 2 and 5 mortality is extremely low, an uncomplicated pneumonia rarely dying; recovery not uncommonly occurs even when child appears moribund. Mortality increases progressively with age: between 20 and 30 years about 20 per cent; at 60 years about 60 per cent.

2. **PREVIOUS HABITS AND CONDITIONS OF HEALTH.**—There is no disease where previous conditions of life are so important in prognosis. In healthy young adults fatalities are rare. The most important factors are:—

a. **ALCOHOL.**—More than doubles mortality. Especially seen in middle-aged labourers.

b. **DEBILITATING DISEASES.**—Especially chronic nephritis, diabetes, cardiac disease, arteriosclerosis, and phthisis.

c. **POOR PHYSIQUE,** previous insufficient food and unhealthy surroundings. Death-rate is higher in cities than in country districts. *Stout individuals* are bad subjects.

3. **FEATURES OF THE ATTACK.**—Conditions influencing prognosis may be considered under the headings: General symptoms and signs; extent of pulmonary lesion; varieties of termination; complications.

GENERAL SYMPTOMS AND SIGNS (approximately in order of importance).—

a. **Toxæmia.**—The degree of toxæmia is the most important sign in an attack.

Lobar Pneumonia—Prognosis, *continued*.

- b. *Condition of the heart and pulse*.—Especially dilatation of right side of heart and rapid small pulse. *If pulse exceeds 130, prognosis is serious*; also if pulse-rate per minute exceeds blood-pressure in mm. of Hg.
- c. *Delirium*.—When marked.
- d. *Pyrexia*.—Duration of considerable importance; degree less so in general. Extremes are serious, viz., hyperpyrexia, over 106°, and low temperature with toxæmia (poor reaction).
- e. *Dyspnœa*.—Rate over 50 is serious, or *pulse-respiration ratio* falling to 2 to 1.
- f. *Insomnia*.—When intractable.
- g. *Leucocytosis*.—Absence is bad sign.

Usually two or more of above coexist, e.g., with toxæmia, commonly rapid pulse, extremes of temperature, absence of leucocytosis. These conditions may be extreme when extent of consolidation is very slight.

EXTENT OF PULMONARY LESION.—Mortality increases with the number of lobes affected: indicating severity of intoxication. *Death is rarely due to asphyxia* from extent of lung involved; toxæmia and cardiac failure are the usual direct causes.

VARIETIES OF TERMINATION.—Abscess and gangrene have very high mortalities. With delayed resolution, exhaustion and cardiac failure may occur.

COMPLICATIONS.—Present in high percentage of fatal cases.

Empyema: the least serious, but, as with all complications, *the earlier the onset in the attack the worse is the prognosis*. All other complications have high mortality.

Meningitis: Always fatal.

Endocarditis and pericarditis: High percentage.

PNEUMONIA AND PREGNANCY.—Mortality is higher in pregnancy, especially in later months. Abortion is common (at least half), and increases in later months, and raises the mortality; and the earlier in the attack it occurs, the higher the mortality. The liability to pneumonia is not increased by pregnancy.

TREATMENT.

There is no specific drug, and the pulmonary inflammation probably is not influenced by any treatment. The aim of treatment is, in general, to maintain the strength, and, in particular, to deal with special symptoms.

General Principles of Treatment.—

1. **GENERAL MANAGEMENT**.—Free ventilation in room. Confined strictly to bed, but position to be varied. Clothing warm but not heavy: a Gamgee or woollen jacket is very suitable, but not essential. Hot-water bottle to feet. Daily sponge with tepid water. In suitable climates should be in the open air. The mouth must be carefully cleansed.

2. DIET.—*Water*, lemonade, or bland fluids must be given freely. In delirium, saline infusions per rectum, or intravenous injections. *Food*: milk, 2 to 3 pints in 24 hours at intervals of 2 to 3 hours. Glucose, eggs, Mellin's or cereal foods may be added.
3. BOWELS.—Give salines or enemata during febrile period. *Purging is inadvisable*: may start diarrhœa. Meteorism treated by turpentine enema, or turpentine stupe or pituitrin.
4. BLEEDING.—In full-blooded patients is indicated by dilatation of right heart or cyanosis. Amount: 10 to 20 ounces.
5. HYDROTHERAPY.—For hyperpyrexia and toxæmia; cold sponging every three hours.
6. OXYGEN AND CARBON DIOXIDE.—Indicated by dyspnœa, cyanosis, cardiac weakness, or delirium.
METHODS.—(1) Oxygen tent—in all severe cases if obtainable; (2) Nasal catheter—can be given continuously; (3) Funnel or mask—less efficient. Gas should be warmed.
7. ANTISERUM AND SPECIFIC THERAPY.—(See BACTERIOLOGY.) Vaccine treatment: at present, no proof of value exists.

Symptomatic Treatment.—

1. RELIEF OF PAIN.—Hot poultices to the side, or an ice-bag. Leeches. For morphia, *see below*.
2. TOXÆMIA.—*Alcohol* (brandy or whisky), freely: also cardiac stimulants. *Hydrotherapy*. *Water freely* by mouth. *Intravenous saline injections* or continuous saline by rectum. *Oxygen*.
3. CARDIAC WEAKNESS.—*Alcohol and hydrotherapy*. Stimulants such as ether, digoxin, camphor, coramine, strychnine, and strophanthin.
4. RESPIRATORY SYMPTOMS.—Expectorant drugs are of little value for the cough, and preferably omitted. For severe cough, heroin may be given (for linctus, *see BRONCHITIS*). For dyspnœa and cyanosis: oxygen tent, bleeding.
5. INSOMNIA.—Often extreme, and difficult to treat, while sleep is essential. Paraldehyde \mathfrak{z} j hourly up to \mathfrak{z} j is frequently effective, or \mathfrak{z} ij repeated after one hour (prescribe with syrup of orange or \mathfrak{z} ss to \mathfrak{z} j whisky and \mathfrak{z} ij water). Medinal.
6. MORPHIA AND HEROIN.—The question of administration is very important. The following general statements may be made. (1) The pain, or, far more important, the insomnia, often yields to no other drug; (2) Sleep is often essential; (3) It is certainly dangerous to give morphia at the crisis; (4) It is impossible to foretell when the crisis will occur. On these it may be observed: *First*—It is safe to give morphia at the onset. Injection of morphia, gr. $\frac{1}{4}$, is good treatment up to five days from onset. *Secondly*—It is dangerous to repeat a hypodermic injection of morphia. *Finally*—Every case must be considered separately, but in doubtful cases it may be remembered that post-mortem findings suggest that most cases which die after morphia would have had a fatal ending in any event.

Lobar Pneumonia.—Symptomatic Treatment, *continued*.

7. DELIRIUM.—*Careful watching*, ice-bags to the head, cold packs, and cold sponges. With patients who have been heavy drinkers, alcohol should be commenced at once.
8. CRISIS.—Collapse, cardiac and respiratory, must be watched for.
9. HYPERPYREXIA.—*Hydrotherapy*. ANTIPYRETICS ARE CONTRA-INDICATED.
10. DELAYED RESOLUTION.—When apyrexial, give respiratory exercises, or blow-bottles. Rest during pyrexia.

Convalescence.—Is extremely rapid. In normal cases, patient may be allowed up in a week and regarded as cured in a fortnight. If cardiac failure has occurred, convalescence must be more gradual.

BRONCHOPNEUMONIA.

(*Capillary Bronchitis. Catarrhal Pneumonia. Lobular Pneumonia.*)

A bacterial infection commencing with inflammation of the bronchioles and extending to the alveoli. Groups of alveoli become filled with cells, mainly by desquamation from the walls.

ETIOLOGY.

Occurs as a primary or a secondary condition. In a third group are cases of aspiration or deglutition pneumonia.

Primary Bronchopneumonia.—Closely resembles lobar pneumonia in etiology, and also in symptoms. Majority of cases in children under 2 years, rare over 4 years.

Secondary Bronchopneumonia.—The following conditions may precede or be predisposing causes:—

1. BRONCHITIS.—The inflammatory process spreads down from the bronchi to the bronchioles.
2. ACUTE SPECIFIC FEVERS.—Especially measles, whooping cough, and influenza; less commonly diphtheria, scarlet fever, and typhoid fever.
3. RICKETS AND DIARRHŒA IN INFANTS.

These three groups are extremely common predisposing causes in infants and children, the secondary bronchopneumonia causing a higher mortality than the original affection.

4. DEBILITATING AND CHRONIC DISEASES IN OLD AGE.—Especially nephritis, cardiac lesions, and arteriosclerosis.
5. TUBERCULOSIS.—A very common cause.

Aspiration or Deglutition Pneumonia.—When matter containing organisms enters healthy bronchi, an intense bronchopneumonia occurs, so severe that suppuration or gangrene may follow. The entry may be due to:—

1. LOSS OF THE LARYNGEAL SENSITIVENESS, as in operations under anæsthesia about the nose and mouth, with tracheotomy, in cancer of the larynx and œsophagus, in coma or uræmia, and in various nervous diseases: particles of food or drink pass the larynx and reach the bronchioles.

2. **PASSAGE OF MATTER** from diseased portions of lung into healthy bronchioles: may occur in bronchiectasis, hæmoptysis, empyema ruptured into lung, abscess of lung, etc.
SEPTIC EMBOLUS of the pulmonary vessels is a special method by which organisms may reach the bronchioles.

Age.—The conditions usually associated with bronchopneumonia at different ages vary greatly. The following is a summary:—

INFANTS.—Under 2 years. Primary bronchopneumonia.

CHILDREN.—Over 2 years (especially 2 to 5 years). Acute specific fevers; rickets; diarrhoea.

ADULTS (uncommon).—Aspiration pneumonia; influenza.

OLD AGE.—Debilitating and chronic diseases.

TUBERCULOSIS AT ANY AGE.

Ether Pneumonia may also be lobular.

Season.—Most common in winter and spring.

MORBID ANATOMY.

Both lungs are affected in at least 60 per cent of cases. The condition of lungs post mortem varies greatly. The essential pathological change is a bronchiolitis; the inflammation spreads to the alveoli, and results in proliferation and desquamation of the epithelial cells lining the wall. The macroscopic appearances depend mainly on the extent to which this alveolar change has progressed.

Three groups may be described which correspond to the stages most often seen: (1) Group with *acute bronchiolitis*; (2) Group with *disseminated bronchopneumonia*; (3) *Pseudo-lobar* form.

1. Acute Bronchiolitis.—Most commonly seen in severe cases which have died in two or three days. Affection of alveoli insufficient to cause visible consolidation. In early cases macroscopically resembles bronchitis: histologically some alveoli found to be affected. On section, congestion and oedema: crepitant: mucopus in bronchi. In cases somewhat later, on section lung has mottled appearance due to minute areas of collapse, consolidation, emphysema, and normal lung.

2. Disseminated Bronchopneumonia.—Common type. Lungs fuller and heavier than usual, but mostly still crepitate.

PLEURAL SURFACE.—Three conditions recognizable, viz.: (a) Depressed purple areas of collapse; (b) Areas of normal lung; and (c) Projecting dark areas of consolidation, over which pleura has lost its polish.

CUT SURFACE.—General dark-red colour. Usually smooth, may be granular. Areas similar to those on pleural surface. Areas of collapse can mostly be inflated through bronchus.

MACROSCOPIC CHARACTERS of an area of consolidation.—Area is a group of affected bronchioles and the related alveoli. Size of small pea, and upwards. Projects slightly above surface. Colour, grayish-red. Surrounds a small bronchus, which is inflamed and plugged with mucopus. Lung in neighbourhood is dark-red, smooth, and airless; due to earlier stage of inflammation.

Bronchopneumonia—Morbid Anatomy, *continued*.

MICROSCOPIC CHARACTERS of an area of consolidation.—

BRONCHIOLE.—Lumen filled with plug of epithelial cells and leucocytes. Wall swollen and infiltrated. May be irregular dilatations.

ALVEOLI.—*Proliferation of epithelial cells lining wall*: lumen occupied by swollen cells already desquamated, and by leucocytes: fibrin scanty or absent: red cells rare. Walls infiltrated with leucocytes, and contain distended capillaries. Changes most marked in alveoli close to affected bronchioles:

3. Pseudo-lobar Form.—Areas of consolidation extensive and coalescent. Intervening areas of congestion usually prevent uniform appearance. Macroscopically may be indistinguishable from true lobar pneumonia, but histologically resembles previous group.

In Aspiration Pneumonia, extensive infiltration with leucocytes occurs throughout affected areas.

BACTERIOLOGY.

No specific organism. In *primary bronchopneumonia*, the bacteriology is probably identical with that of lobar pneumonia, i.e., most commonly due to pneumococci alone; other organisms may be streptococci and staphylococci, usually in association with pneumococci. In *secondary cases*, the infection is usually mixed, two or more organisms being present, of which pneumococcus is commonly one. Common organisms are streptococci, staphylococci, and the influenza bacillus: less common are *Micrococcus catarrhalis*, diphtheria and typhoid bacilli, and Friedländer's pneumobacillus. Occasionally such organisms as *B. pyocyaneus* and *Micrococcus tetragenus*, practically confined to aspiration and septic cases.

SYMPTOMS AND CLINICAL COURSE.

Primary Bronchopneumonia.—This variety, in its onset and symptoms, physical signs, diagnosis, prognosis, and treatment, may be regarded as identical with lobar pneumonia occurring at a similar age. The distinction depends on morbid anatomy and histology, and the diagnosis is rarely made definitely during life. Mortality is low. This form will not be referred to again.

Secondary Bronchopneumonia.—There is no distinctive clinical course, and symptoms and signs are less definite than in lobar pneumonia.

NATURE OF ONSET.—During convalescence and while suffering from a predisposing cause, commences as bronchitis, and symptoms pass into those of bronchopneumonia, usually slowly but rarely suddenly.

At first slight indisposition. Then actual onset shown by symptoms: *pyrexia, cough, rapid respiration and pulse, and fine râles* on auscultation.

TEMPERATURE.—Usually 102° to 104° F. Generally marked daily variations, 3° F. or more. Never falls by crisis. Hyperpyrexia is bad sign. In severe cases pyrexia may be slight.

COUGH.—Frequent : usually feeble : vigorous cough a good sign.

RESPIRATION.—Rapid, often 60 or more ; increases in proportion to extent of lung affected. May be jerky. Pause after expiration common. Retraction of lower ribs and sternum during inspiration points to deficient lung expansion, and is a serious sign.

PULSE.—Rapid, usually small, but may be full at onset.

CYANOSIS.—In severe cases. Always a serious sign. First seen on lips. In grave cases pallor follows.

The above symptoms are the most characteristic and important. Other symptoms are :—

SKIN.—Dry or moist, but rarely pungent.

SPUTUM.—Young children swallow sputum. In old patients, scanty thin mucus, or mucopus.

HERPES.—Not common.

APPETITE.—Impaired. Thirst may be great.

NERVOUS SYMPTOMS.—Marked only in grave cases.

Progress of Severe Case.—Asphyxia and toxæmia develop. Anxious expression. Cyanosis, then lividity. Cough diminishes as toxæmia increases. Râles widespread as tubes fill with secretion. Patient becomes restless and sleepless. Inspiratory retraction of ribs marked. Right ventricle dilates. Death occurs.

Terminations.—Primary and secondary cases end almost invariably in resolution or death.

Other terminations are : *Fibrosis*, leading to chronic bronchopneumonia. Common in tuberculous form, rare in others. *Suppuration* or gangrene : the common termination of aspiration pneumonia. Very rare in others. Mortality very high.

Cause of Death.—May be : (1) Asphyxia and toxæmia ; (2) Heart failure ; (3) Exhaustion in protracted cases.

PHYSICAL SIGNS.

Vary greatly. Diagnosis mainly by auscultation.

AT ONSET.—Signs of capillary bronchitis and congestion, viz., percussion note resonant, fine râles, breath-sounds feeble.

LATER.—Râles louder, breath-sounds harsh, vocal resonance louder. On percussion, impaired resonance may be recognized, but definite dullness is rare, and often there is no change.

Death often occurs without these later signs, but extensive areas of consolidation may be found.

DIAGNOSIS.

From the following three conditions diagnosis may be difficult :—

1. **ACUTE BRONCHITIS.**—At onset diagnosis may be impossible. High temperature, severe constitutional disturbance, and localized bronchitis occurring in children are usually due to bronchopneumonia, simple or tuberculous.

2. **LOBAR PNEUMONIA.**—Diagnosis is difficult when large areas of bronchopneumonia are confluent (pseudo-lobar form).

PRIMARY BRONCHOPNEUMONIA.—Most common in children under 2 years, while lobar pneumonia is more common after 2 years of age. Diagnosis is of little importance.

Bronchopneumonia—Diagnosis, *continued*.

SECONDARY BRONCHOPNEUMONIA.—Special differences : *Child previously in ill-health, onset insidious, affection bilateral.*

3. TUBERCULOUS BRONCHOPNEUMONIA (q.v.).—Diagnosis usually possible only by duration : suspected after four weeks. May be suggested by affection of apices, by signs of caseation, and by wasting, but not with certainty. Tubercle bacilli occasionally found in vomit in children, due to swallowed sputum, and very rarely in the fæces.

Cerebral symptoms occasionally suggest meningitis.

PROGNOSIS.

In adults, mortality is very high in *aspiration pneumonia*, and when intercurrent in chronic diseases.

In children, mortality low in *primary form*.

Secondary Bronchopneumonia in Children.—

MORTALITY.—Under 5 years 30 to 50 per cent; in private practice 10 to 20 per cent. Prognosis varies with :—

AGE.—Mortality greatest under 1 year; it decreases steadily with age.

PREVIOUS CONDITION.—With rickets or after acute specific fevers more severe than following bronchitis. Second attack worse than first if interval is short. Thin children do better than fat ones.

TEMPERATURE.—Temperature over 105° , or high and irregular, or low with extensive lung signs, are all unfavourable. Best sign is steady high temperature, 102.5° to 104° .

In a given case prognosis depends on *temperature, cyanosis, extent of lung involved, nervous symptoms, and state of digestive organs*. In protracted cases, vomiting and gastric disturbance are serious. No case is ever hopeless.

TREATMENT.

(See also LOBAR PNEUMONIA.)

PROPHYLAXIS.—Of great importance. In predisposing conditions, especially measles and whooping-cough in children, great care should be taken to prevent chills.

GENERAL MANAGEMENT.—Confinement to bed, but infants may be nursed. Position changed frequently to assist emptying tubes. Jacket of Gamgee next chest. Room well ventilated, but no draughts. Steam kettle.

DIET.—Milk and milk-foods in plenty. At regular intervals (about 2 hours). Water freely by mouth, and rectal salines if needed.

ALCOHOL.—Extremely valuable, preferably as brandy. To an infant one ounce daily. Always in severe cases.

BOWELS.—Castor oil or calomel.

PYREXIA.—Antipyretics should never be used. Above 105° reduce by hydrotherapy : tepid baths to infants : cold sponging to children most convenient. With asthenic low temperatures attempt to increase warmth : wrap limbs in cotton-wool : hot bottles : hot baths : mustard baths.

Cerebrospinal Fever, *continued*.**Etiology.**—

AGE.—Incidence greatest up to 5 years, in normal circumstances.

SEASON.—Highest in first half of year: attributed to confinement in dwellings and prevalence of colds and coughs.

OVERCROWDING.—The 'carrier rate' among soldiers increases as distance between bunks is decreased. Cubic space is a lesser factor.

Influence of fatigue doubtful.

Mode of Infection.—Animals are not susceptible (except monkeys experimentally): hence infection is solely from man to man; spreads by droplet infection; fomites are not infectious. Infection is from 'carriers', direct infection from a patient being very rare. Epidemics thus spread irregularly, cases apparently being unconnected.

'CARRIERS'.—May be: (1) Convalescent carriers: subsequent to an attack: cultures (from nasopharyngeal swabs) usually negative in a few weeks: rare cases become chronic carriers. (2) Chronic carriers: few only have had symptoms, or develop them. Susceptibility is low. In a healthy population, 5 per cent may be carriers: cases begin to be frequent when carrier rate is 20 per cent.

PATH OF INVASION.—Nasopharynx is infected initially. Theories of the path to the meninges are:—

1. DIRECT TO THE MENINGES BY LYMPHATICS.—Pus is sometimes found in the sphenoidal sinuses (Embleton), and possibly spread may be direct by lymphatics.
2. INVASION OF THE BLOOD.—Producing a *meningococæmia* with subsequent localization in the meninges. Early in the disease meningococci may be isolated by blood cultures. This is probable path.

Bacteriology.—

Diplococcus intracellularis meningitidis, or *Meningococcus*, discovered by Weichselbaum in 1887.

MORPHOLOGY.—Mainly in pairs. In cerebrospinal fluid and pus most, but not all the organisms are within the leucocytes (intracellular). Shape either round or flattened. Gram-negative. Thus closely resembles gonococcus.

CULTURES.—Grow most readily on Gordon's 'tryagar'; large colonies, somewhat opaque. Less readily on ascitic agar. On ordinary agar growth more delicate and often fails. Cultures die readily, and subcultures are necessary every few days. *Involution* forms are common in cultures, cocci being swollen and staining badly. Identify cultures by agglutination.

GORDON'S TYPES OF MENINGOCOCCI.—By agglutination with antisera, prepared by inoculating animals with various strains, Gordon has separated 4 types, I, II, III, and IV. Types I and II occur with about equal frequency, forming 90 per cent of all strains: Type IV is very rare. Types I and III are akin to some extent, and classed as Type A by certain authorities: similarly

Types II and IV have been classed as Type *B*. Type *B* is also known as parameningococcus and Type *A* as meningococcus. Types III and IV occur mainly in septicæmic forms.

PRESENCE AND ISOLATION OF MENINGOCOCCUS.—

1. Nasopharynx and accessory sinuses in 'carriers'.

2. Blood in early stage of disease. Isolated in about 25 per cent.

3. Cerebrospinal fluid during disease.

Rarely isolated from nasopharynx during disease.

AGGLUTININS.—Appear in blood about fourth day: to infecting strain only.

ANTISERA.—Produced in horses and monkeys: only effective against homologous strain. Type II serum is of low valency.

Morbid Anatomy.—General characteristic is a suppurative inflammation of pia-arachnoid, especially at base of brain. In very acute cases (meningococcal septicæmia) condition of hyperæmia only may be present.

CEREBRAL MENINGES AND BRAIN.—Pia-arachnoid injected, and purulent exudate in subarachnoid spaces, especially at base. On cortex often much lymph, especially in larger depressions. Brain substance soft and pink; may be foci of hæmorrhages. Ventricles distended with fluid or even with pus. Microscopically, infiltration along vessels and other channels, and may be foci of encephalitis.

SPINAL CORD.—Always affected, especially posterior surface, and in dorsal and lumbar regions. Pus may surround all the cord, and even nerve roots.

In more chronic cases *meninges* are thickened and remains of exudate present. Cranial nerves usually involved. *Ventricles* may be greatly distended with clear or turbid fluid, and foramen of Magendie closed.

OTHER ORGANS.—Usually these show little change. Spleen occasionally enlarged. May be terminal pneumonia.

Duration of Infectivity.—Until nasopharyngeal swabs are negative.

Quarantine Period.—Seven days.

Symptoms.—

INCUBATION PERIOD.—From 1 to 4 or 5 days.

MODES OF ONSET.—(1) *Ordinary type*: Sudden onset. Condition becomes progressively worse, suggesting cerebrospinal meningitis in 24 hours. (2) *Fulminating type*: Abrupt onset. May be mania. Progress very rapid. Comatose within few hours.

Ordinary Form.—*Onset*: Sudden, with headache, vomiting, pyrexia, rigors, and, in children, convulsions. Temporary improvement occasionally follows onset. *Stiffness of neck*, head retraction, and general irritability develop. General condition of irritation of the nervous system and increased intracranial pressure. Symptoms usually take one to five days to develop, and remain at height for one to three weeks. Spleen may be palpable.

Cerebrospinal Fever—Symptoms, *continued*.

MOTOR SYMPTOMS.—

1. HEAD RETRACTION.—May be extreme. In infants, opisthotonos.
2. RIGIDITY.—(i) Kernig's sign, rarely absent. (ii) Brudzinski's 'neck sign': if the head is flexed by the hand, with the patient lying on his back, flexion of the knees and thighs occurs (a valuable sign of meningitis). (iii) Brudzinski's 'leg sign': if one leg be flexed, flexion also occurs in the opposite leg.
3. REFLEXES.—Deep reflexes (knee-jerks) usually increased. Babinski's sign in about 10 per cent.
4. SPASMS.—Commence as twitching, increasing to clonic or tonic spasms. Spasms or paralysis of face muscles. Tremor common.
5. OCULAR SYMPTOMS.—(i) Pupils: Usually dilated, from irritation of sympathetic; may be contracted, in severe forms. Inequality and sluggish reaction common. Hippus not infrequent. (ii) Strabismus: In about 20 per cent. (iii) Optic neuritis: Uncommon; about 10 per cent. Photophobia, conjunctivitis, ptosis, nystagmus occasionally.

SENSORY SYMPTOMS.—Headache often very severe, especially occipital. Pain may extend along spine and limbs. General hyperæsthesia may occur.

PSYCHICAL SYMPTOMS.—At onset restlessness, mania, or delirium, later stupor and coma.

VOMITING.—Of the cerebral type, very frequent at onset, may continue or subside later.

TEMPERATURE.—Irregular, no typical course, remissions and intermissions common; may rise to 105° or over; about 103° usual.

PULSE.—Slow in relation to temperature, may be irregular.

RESPIRATION.—Towards termination may be Cheyne-Stokes. Only increased with pulmonary complications.

ERUPTIONS.—

1. HÆMORRHAGIC RASH.—Onset early, 1st or 2nd day. Either (a) petechial, or (b) purpuric (fulminating cases only). Rare.
 2. HERPES LABIALIS.—In 25 to 50 per cent. Onset not before 4th or 5th day.
 3. ERYTHEMA.—May resemble typhoid.
- BLOOD.—Polynuclear leucocytosis, 25,000 to 50,000 per c.mm. Leucocytosis may be absent in fulminating cases.
- EMACIATION.—Often very rapid.

Other Clinical Types.—

1. FULMINATING FORM.—Abrupt onset: headache, vomiting, collapse: purpuric rash common. Temperature high or low. Rapid coma. Death in a few hours. Cerebrospinal fluid may be clear and contain no cocci. Hæmorrhage in medulla of suprarenals frequent (the medulla is of nervous origin). Meningeal symptoms slight or absent. Abdominal symptoms may occur.

2. MILD AND ABORTIVE FORMS.—Symptoms mild or subsiding in a few days.
3. CHRONIC FORMS.—Recrudescences may occur over many months. Other chronic forms are associated with closure by meningitis of the foramina of Magendie and Luschka: the ventricles are distended either with pus, turbid fluid, or clear fluid, constituting 'closed ventricular meningitis' or hydrocephalus. Complex nervous manifestations, emaciation, disturbances of pulse and respiration: recovery impossible. Common in posterior basic meningitis.
4. MENINGOCOCCIC SEPTICÆMIA.—Types: (a) Fulminating form (*see above*); (b) Without meningeal symptoms and with complete recovery in short period; (c) Prolonged course—may end in acute meningitis after several weeks.

POSTERIOR BASIC MENINGITIS.—Cerebrospinal meningitis in infants. Commonest form of meningitis under age of one year. Onset sudden or insidious. Note: (1) Head retraction and opisthotonos marked; (2) Rash rare; (3) Loss of vision without optic neuritis common; (4) Often very chronic; (5) Sequelæ usual in non-fatal cases: deafness and hence deaf-mutism, blindness, mental deficiency, general spasticity of extremities (hydrocephalus). Lumbar puncture in chronic cases often gives 'dry tap', from closure of foramen of Magendie.

PROGNOSIS.—Death: 50 per cent. Complete recovery: 15 per cent. Various sequelæ: 35 per cent.

Complications and Sequelæ.—

NERVOUS SYSTEM.—Facial paralysis, hemiplegia, and paraplegia occur rarely: recovery usual. In the chronic forms and hydrocephalus, attacks occur with headache, vomiting, mental dullness, and dilated pupils.

ARTHRITIS OR SYNOVITIS.—Occurs in 5 to 10 per cent: a previous hæmorrhagic rash is almost invariable. Suppuration is rare and prognosis good.

EAR.—Deafness not uncommon, and often permanent, probably from affection of internal ear and auditory nerve. Otitis media also not uncommon.

RARE COMPLICATIONS.—Pericarditis. Pneumonia. Epididymitis.

RECRUDESCENCES.—Common. True relapses rare.

Cerebrospinal Fluid.—

CHARACTERS.—(1) *Amount increased* and under abnormal pressure; (2) Fluid *turbid* or purulent; (3) *Protein increased*; (4) *Polynuclear leucocytes* present in deposit (lymphocytes in early stages); (5) *Meningococci* present, intra- and extracellular—but may be absent even with turbid fluid; (6) *Dextrose absent*: the cause of this is doubtful, possibly fermented by meningococci, or due to action of leucocytes. The fluid may be clear for the first 24 hours. In later stages, with closure of foramen of Magendie by meningitis, amount of fluid may be scanty. Mixed infections occasionally occur, usually pneumococci.

Cerebrospinal Fever, continued.**Diagnosis.—**

CLINICAL CHARACTERISTICS.—At onset: headache, vomiting, pyrexia, stiffness of neck, and delirium: development of head retraction.

SPECIAL METHODS.—(1) Lumbar puncture: pathognomonic except occasionally in first 24 hours. (2) Blood-count and blood-culture: of less value.

DIAGNOSIS FROM.—(1) Other conditions which produce meningeal symptoms: typhoid fever, pneumonia, influenza, otitis media. (2) Other causes of meningitis: tuberculous, septic, or pneumococcal. (3) Acute poliomyelitis. (4) Encephalitis lethargica. (5) Typhus, and rarely other conditions with purpuric eruptions. (6) Subarachnoid hæmorrhage (may recur).

Prognosis.—Bad in: (1) Infancy and over 40 years of age; (2) Fulminating forms; (3) Purpuric rashes; (4) Pulmonary complications. Condition of cerebrospinal fluid of comparatively little value unless cocci very numerous: pus may disappear rapidly. Temperature of little prognostic value.

DURATION.—Very variable. Death frequently towards end of first week, but may occur later.

CONVALESCENCE.—Many months.

MORTALITY.—Without serum 50 to 70 per cent: with efficient serum treatment should not exceed 30 per cent.

Treatment.—

LUMBAR PUNCTURE.—Should be performed at once, even in doubtful cases, for diagnosis and for introduction of serum. Withdrawal of fluid relieves headaches and reduces intracranial pressure, but must be combined with serum treatment.

SERUM TREATMENT.—Should never be omitted even in doubtful cases.

ESSENTIALS are: (1) Early injection; (2) Serum employed must contain antibodies to the infecting strain.

ANTISERA IN Use include: (i) Flexner's serum, polyvalent, prepared from numerous strains; (ii) Medical Research Council's monotypical sera for each of Gordon's Types (Gordon); (iii) Medical Research Council's pooled serum for Types I and II. Before the type of meningococcus is ascertained, either Flexner or the M.R.C. pooled serum should be used. *Note.*—Types I and II include 90 per cent of all cases.

DOSAGE.—On first 2 days, 30 to 40 c.c. for an adult, 20 to 30 c.c. for a child, repeated twice. On next 4 days, 20 to 40 c.c. daily: subsequently continue daily until fluid clear and temperature falls. Repeat if recrudescence occurs. At onset, if fluid is clear, an intravenous injection is recommended in addition to above to neutralize the meningococcal septicæmia (200 to 500 c.c.).

TECHNIQUE.—Warm serum to body temperature. Perform lumbar puncture and allow cerebrospinal fluid to drip away. The amount of serum *must never exceed* the amount of fluid

removed. The serum is introduced by gravity: the barrel of a syringe being connected to the trocar by a rubber junction; the serum *must not be forced* into the thecal space.

GENERAL HYGIENE AND TREATMENT.—As in tuberculous meningitis. Feeding through nasal tube should be employed without hesitation, as a nutritious diet is of great importance. Local treatment to nasopharynx is of doubtful value.

Hexamine (urotropine): Value is not proved, but drug is harmless: is secreted into cerebrospinal fluid. For adult, gr. x, t.d.s.; for infant, gr. ij.

Prophylaxis.—

1. **GENERAL HYGIENE.**—Fresh air and sufficient cubic space in barracks, etc.
2. **SEARCH FOR CARRIERS.**—The elimination of carriers would extinguish the disease, but cannot be carried out completely. Many carriers also appear to be intermittent, regarding results of examination. When a case has appeared, contacts should be examined by swabs of the nasopharynx.

TREATMENT OF CARRIERS.—At present unsatisfactory. Various forms of local sprays, and steam sprays, have been employed. Vaccines useless.

CHAPTER VII.

INFLUENZA.

An acute infectious disease especially attacking the respiratory tract, but characterized by the variability of the symptoms, a post-febrile nervous stage, and widespread epidemics. The *B. influenza* has been isolated in many epidemics and sporadic cases.

Etiology.—A pandemic occurred in 1889-90. It commenced probably in Turkestan, and spread from East to West, becoming world-wide within 12 months. Epidemics recurred in 1891 and 1892, in the latter year being almost pandemic. In subsequent years, local epidemics occurred, but on a smaller scale. Propagation is direct from person to person: infectivity is very high and spread very rapid. Epidemics are independent of personal, seasonal, and usual epidemiological factors. One attack in no wise protects, but the progress and cessation of epidemics suggest that a nation may acquire some immunity. The rapidity of spread depends on the shortness of the incubation period, universal susceptibility, and the frequency of mild neglected cases.

EPIDEMIC of 1918.—Healthy young adults specially attacked. Cyanosis early and marked; pneumonia frequent. Mortality very high. Little variability in symptoms, and complications rare.

Bacteriology.—*B. influenza* was discovered by Pfeiffer in 1892, and practically simultaneously by Kitasato and Canon. (Also called *Hæmophilus influenza*.)

Influenza—Bacteriology, *continued*.

MORPHOLOGY.—Minute non-motile bacillus or cocco-bacillus. Straight with round ends. Does not form spores. In sputum and body fluids occurs singly and in clumps, both intra- and extracellular. Gram-negative. Stains with all ordinary stains.

CULTURAL CHARACTERISTICS.—Isolated best on *Pfeiffer's blood-agar* (blood spread on agar). Forms transparent colonies. Growth delicate, dies rapidly in subcultures. *No growth on ordinary media: hæmoglobin is essential. Pure aerobe.*

DISTRIBUTION IN THE TISSUES.—In the respiratory tract, bronchi, bronchioles, and lung. In sputum often in large numbers. In pus from empyemata may be present in pure culture, but streptococci and other organisms often present. Rarely isolated from the blood. Occasionally isolated in meningitis, otitis media, and other lesions following influenza.

VIRUS OF INFLUENZA.—*Pfeiffer's bacillus* was generally accepted as the cause of the epidemic of 1889 and immediately succeeding years. Now doubtful: probably a filtrable virus. Ferrets inoculated nasally with filtrate of human influenzal garglings develop influenzal symptoms, transmissible back to man. Antibodies to this virus present in blood of convalescents (*Laidlaw*). Researches still in progress.

Morbid Anatomy.—In fatal cases, inflammatory changes in the lungs are invariably present, most commonly bronchopneumonia: no specific lesions. In 1918 lungs were often slate-blue and hæmorrhagic.

Quarantine Period.—Five days is sufficient.

Symptoms.—

INCUBATION PERIOD.—Two to five days.

The symptoms are extraordinarily complex and variable, but certain types can be recognized: (1) General febrile type; (2) Respiratory; (3) Nervous; (4) Gastro-intestinal.

1. **GENERAL FEBRILE TYPE.**—Under this heading are described the general features commonly seen in an attack of influenza.

ONSET ABRUPT.—Often sudden severe vertigo.

FACIES.—Suffused. Conjunctivitis.

HEADACHE.—Severe. Frontal or very frequently at back of eyeballs. Pain on movements of eyes.

PAIN IN BACK AND IN BONES.—Often very severe.

TONGUE.—Furred, and breath offensive.

CORYZA.—Bronchitis common.

PROSTRATION RAPID.

CHILLS.—Especially sensation of 'goose-flesh'. Later on drenching sweats.

FEVER.—Lasting three to five days. Pulse usually not increased in proportion to temperature.

PHYSICAL SIGNS.—A few râles at the bases or nothing at all. Spleen occasionally palpable.

RELAPSES.—Common.

Acute symptoms usually last about one week.

The general febrile form may develop into any of following types, or these may dominate the symptoms from onset.

2. **RESPIRATORY TYPE.**—Respiratory symptoms marked. Practically always lobular. Cyanosis early.

BRONCHITIS.—Sputum usually in very large amounts: may be purulent. Scattered râles in lungs.

PLEURISY.—Empyema very frequently follows. Streptococcus or pneumococcus usually present, less commonly *B. influenzae*.

PNEUMONIA.—Always serious; accounts for nearly all deaths.

3. **NERVOUS TYPE.**—Symptoms variable. May be very severe. Headache, insomnia, delirium, prostration common.

4. **GASTRO-INTESTINAL TYPE.**—Rare. Attack may commence with abdominal pain and profuse diarrhoea; may be nausea and vomiting. Respiratory symptoms often entirely absent. Jaundice may occur. Spleen may be enlarged.

THE HEART.—May be especially affected. In acute stage, rapid, irregular pulse. Myocardial weakness common in convalescence, with liability to tachycardia and dilatation.

FEVER.—Variable, no typical course, usual duration about five days; may last three weeks.

BLOOD.—Leucopenia (4000 to 2000 per c.mm.) with relative lymphocytosis. Polynuclear leucocytosis occurs with complications, especially pulmonary.

Complications and Sequelæ.—There is almost invariably depression of physical, and, more especially, mental powers. Frequently also vertigo, palpitations, and vague neuralgia.

NERVOUS SYSTEM.—

• *Psychical sequelæ* of all varieties from depression to suicidal tendencies. Common are insomnia, loss of smell and taste, irritability of temper, also many forms of neuralgia and neuritis. Neurasthenia or melancholia may last for months, or rarely years.

Numerous lesions have been described, e.g., acute polyneuritis, paralyses of all types.

RESPIRATORY SYSTEM.—Pulmonary complications are very important and frequent: *pneumonia*, which may terminate in gangrene; *chronic bronchitis* is common; rarely bronchiectasis.

CIRCULATORY SYSTEM.—Vertigo, palpitations, tachycardia, and cardiac weakness may be persistent. Acute dilatation and sudden death rare. Infective endocarditis, pericarditis, rare.

SUPPURATION.—Local abscesses may form in any site, especially middle ear, antrum of Highmore, and superficially.

Rarer complications are thrombosis of vessels and nephritis.

Diagnosis.—During an epidemic, diagnosis is usually easy. In sporadic cases and small outbreaks, diagnosis frequently made solely by the extreme prostration in the post-febrile stage: often very uncertain.

Prophylaxis.—During epidemics avoid crowded places. Gargle regularly. Nurses and attendants should wear masks.

Influenza, *continued*.

Treatment.—

GENERAL TREATMENT.—Confine to bed until temperature has been normal several days and *no râles are present in lungs*.

DRUGS.—There is no specific, but a course of quinine should be given, or aspirin (gr. xv, t.d.s.).

BOWELS.—Commence with calomel (gr. ij) on first night and saline in morning.

INITIAL CORYZA.—Tinct. quin. ammon. ʒj every 4 hours.

HEADACHE.—Phenacetin gr. x.

SEVERE GENERAL PAINS.—Aspirin or sodium salicylate (gr. xx every 4 hours). Dover's powder gr. x.

INSOMNIA.—Paraldehyde ʒj, in whisky.

COUGH.—Heroin or a simple linctus. (*See ACUTE BRONCHITIS*.)

HYPERPYREXIA AND DELIRIUM.—Treat as in typhoid fever.

CARDIAC WEAKNESS.—Alcohol, digitalis, and strychnine.

Localized symptoms in lung and alimentary system need the appropriate treatment.

CONVALESCENCE.—Change of air, good diet, arsenic and quinine; avoid chills.

PROPHYLACTIC INJECTIONS.—Vaccine containing per c.c. *B. influenza* 500 million, pneumococci 1000 million, streptococci 100 million. Two injections, 0.5 and 1 c.c., at intervals of a week. Repeat every six months. Probably valueless.

CHAPTER VIII.

WHOOING-COUGH.

(*Pertussis*.)

A specific infectious disease characterized by catarrh of the respiratory tract and paroxysms of coughing terminating in a 'whoop'.

Etiology.—Sporadic cases common. Epidemics frequent. Temperate climates especially affected.

SEASON.—Most prevalent in winter and spring. Maximum in March, minimum in September.

AGE.—Usually under six years, but no age immune. Not uncommon in infants. In old people usually severe.

Females in excess of males. *One attack usually protects*. Association with measles very common. *Susceptibility* great but not universal.

Bacteriology.—Bordet-Gengou, in 1906, described the *Bacillus pertussis* (also called *Hæmophilus pertussis*). Isolated on special blood-agar media from tenacious mucus voided at end of paroxysms. Absent or difficult to isolate in later stages. A small, Gram-negative, non-sporing bacillus resembling *B. influenza*. *Complement-deviation* occurs with the serum of convalescents. Agglutinins may also be present. The bacillus is generally accepted as the cause of whooping-cough, but proof is not yet absolute.

Morbid Anatomy.—No specific changes. Lesions post mortem usually those of some fatal complication. In uncomplicated fatal cases, areas of collapse and emphysema; enlarged tracheal and bronchial glands.

Mode of Infection.—*Direct contagion* from the sputum. A very short exposure may be sufficient. The cough can probably project particles to some distance, but with precautions the tendency to spread, e.g., in a ward, is considerably less than with measles. Transmission by fomites, infected clothes, etc., is definitely proved, but probably rare. Cats and dogs are subject to whooping-cough.

Duration of Infectivity.—*Six weeks from onset*, or four weeks from onset of paroxysms: until whoop has been absent for two weeks and until paroxysms *cease to be frequent*. After cessation of 'whoop', cough may remain paroxysmal; it is unnecessary to regard this stage as infectious, if the foregoing provisos are fulfilled.

Quarantine Period.—Three weeks.

Symptoms.—Divided into catarrhal and paroxysmal stages.

INCUBATION PERIOD.—Six to 18, often 10 to 14 days.

1. **CATARRHAL STAGE.**—*Onset insidious*. Commences with slight malaise, coryza and cough: not severe, but cough out of proportion to catarrh. Slight bronchitis in lungs. *Pyrexia* slight and intermittent. Some gastric disturbance.

COUGH.—Becomes more frequent and paroxysmal, especially at night: inspiratory spasms develop; finally characteristic whoop starts. In some cases, whooping occurs almost at once: in others greatly delayed, or not at all.

2. **PAROXYSMAL STAGE.**—Dated from first whoop. Coryza has previously subsided. *Pyrexia* slight or absent.

COUGH.—Course of events in typical paroxysm: (i) *Long inspiration* (often absent), followed at once by (ii) *Series of short expiratory barks*. Thorax fixed, no air enters, face becomes congested. When apparently suffocating, (iii) *Inspiratory whoop*. Congested appearance rapidly passes, but child is exhausted. *Vomiting frequently follows* even in catarrhal stage, and suggests diagnosis. Cycle may recur several times in succession. May be small amount of tenacious mucus at end of paroxysm. Number of *paroxysms* up to 40 a day: *distinctly more frequent at night*. Child becomes aware of oncoming paroxysm, makes attempts to suppress it, and becomes terrified. After attack sleeps, or older children complain of headache. Violent sneezing may precede or follow paroxysm.

FACE.—Often bloated from the constant congestion: swelling most marked about the eyes: often suggestive.

SUBLINGUAL ULCER.—Occasionally present: confined to infants with only two lower central incisors erupted. Never before paroxysmal stage.

Whooping-cough—Symptoms, continued.

PAROXYSMS.—Usually spontaneous : may be excited by close atmosphere, crying, eating, excitement, or recumbent position. Infants, whoop usually absent : in aged, an occasional whoop.

Physical Signs.—In lungs : very slight. During expiratory coughs, resonance may be defective and a few râles at bases. Pulse becomes very rapid.

Blood Changes.—The total of leucocytes is increased, but more characteristic is the increased percentage of lymphocytes ; this may rise to 80 per cent. Present early in catarrhal stage.

Progress.—Paroxysms become less frequent and less severe, and the whoop gradually disappears.

Duration.—Very variable. *Catarrhal stage*, about one week, from three days to two weeks. *Paroxysmal stage*, four weeks and upwards. *Total duration*, usually six to eight weeks, but may be greatly prolonged. *Adenoids* may cause prolongation.

Complications.—Important.

1. **PULMONARY COMPLICATIONS.**—Cause nearly all fatalities.
CAPILLARY BRONCHITIS AND BRONCHOPNEUMONIA.—Child remains ill between the paroxysms. Whoop may disappear. Sometimes is tuberculous. Lobar pneumonia rare.
COLLAPSE OF LUNGS.—Especially in rickety infants. Due to blockage of air-spaces by tenacious secretion.
EMPHYSEMA.—May develop. Rarely pneumothorax.
 Inspiratory whoop may not occur, and suffocation results, but very rare.
2. **VOMITING AND EMACIATION.**—The normal vomiting may become excessive.
3. **ENLARGEMENT OF BRONCHIAL GLANDS.**—Very frequent.
4. **CONVULSIONS.**—Common in infants. Usually fatal.
5. **VENOUS CONGESTION AND HIGH PRESSURE.**—During paroxysms, may cause various complications : (1) Hernia ; (2) Prolapse of rectum ; (3) Hæmorrhages, e.g., petechial rashes, conjunctival ecchymosis. Rarely meningeal hæmorrhage, fatal.

ALBUMINURIA occasionally, but nephritis very rare.

PARALYSES AND PERIPHERAL NEURITIS.—Very rare.

Sequelæ.—

TUBERCULOSIS, pulmonary or glandular, not uncommon sequel.
CHRONIC PULMONARY DISEASES, e.g., bronchitis, also emphysema. Ordinary coughs may subsequently tend to be paroxysmal ; and in adults asthma may develop.

DEFORMITIES OF THE THORAX, e.g., 'pigeon-breast', may follow a prolonged attack.

CARDIAC WEAKNESS may result from the repeated strain.

RELAPSES AND SECOND ATTACKS.—Rare.

Diagnosis.—

CATARRHAL STAGE.—Often very difficult. Note: (i) Cough out of proportion to signs in lungs; (ii) Cough becoming paroxysmal, especially at night; (iii) Cough accompanied by vomiting.

PAROXYSMAL STAGE.—Typical cases easy, but in young infants whoop may be absent throughout.

BLOOD.—Changes not present in early catarrhal stage; develop during paroxysmal stage and persist into convalescence: (1) Leucocytes increased up to 30,000, and in severe cases to 80,000 or more; (2) Small lymphocytes 60 to 85 per cent.

SPECIFIC METHODS.—(1) Culture of sputum—droplets during paroxysm received on Petri dish ('cough plate method'); (2) Blood changes; (3) Complement-deviation test.

Cause of the Whoop.—Uncertain. Has been ascribed to laryngeal spasm from local irritation of larynx by mucus (doubtful). Possibly specific irritation of vagus.

Prognosis.—**MORTALITY:** varies greatly with age: under 1 year high, and under 3 years considerable; over 5 years, less than 1 per cent; severe in the aged. **CONVULSIONS:** high mortality. **BRONCHOPNEUMONIA:** accounts for most deaths. Tuberculosis and chronic pulmonary diseases not infrequently develop later.

Treatment.—

1. **GENERAL TREATMENT.**—Preferably isolated in two rooms. Temperature maintained at 60° to 63°. *Fresh air essential.* Confine to bed during catarrhal stage or pyrexia. Cotton-wool jacket. Support child during paroxysm. Abdominal binder comforting. Confine to rooms for three weeks at least, not necessarily in bed.

2. **DIET.**—Milk and milk foods and meat-juice: small and frequent meals. Food well administered immediately after a paroxysm.

3. **DRUGS.**—Eucalyptus oil should be sprinkled on the bed-clothes, or may be evaporated in a saucer over a spirit lamp, or from a steam kettle (3j to a pint). The nose and throat may be sprayed with a simple antiseptic, e.g., listerine and glycerin, *unless this causes paroxysms*, but should not be attempted in young children. Rub chest with a stimulating liniment (lin. camphor. for infants; lin. camphor. ammon. for children).

1. **CATARRHAL STAGE.**—Expectorants, as in bronchitis.

2. **PAROXYSMAL STAGE.**—Give sedatives. Bromoform (℥ss to ℥iij on sugar) and potassium bromide are suitable. Belladonna, a traditional remedy, should be given in full doses, combined with sedatives: dose ℥j, t.d.s., at age of one year. Paregoric (tinct. camphoræ co.) is valuable, especially a dose at night. Heroin is perhaps the best drug, given as a linctus: for prescription, *see* BRONCHITIS.

4. **SPECIAL ANTI-SPASMODIC TREATMENT.**—No treatment is specific in spite of claims. Methods include: adrenalin, benzyl benzoate, ether injections. Vaccine treatment: no evidence of value. Light treatment: general effect only.

Whooping-cough—Treatment, *continued*.

CONVALESCENCE.—Great care should be taken to avoid chill, owing to risk of tuberculosis and pulmonary diseases, but fresh air is of greatest importance, and child need not be confined to the house until all paroxysms have ceased. Give cod-liver oil and malt and iron tonics, e.g., syr. ferri phosphatis co.

If attack is prolonged, try change of climate: examine for adenoids, and remove if present.

Measles is not uncommon during convalescence.

CHAPTER IX.

GONOCOCCUS INFECTIONS.

An infection by the gonococcus, with a primary lesion usually in the urethra, various lesions in the genital tract due to direct extension, and a liability to systemic infection. The lesions in the genital tract are not described here.

Etiology.—In new-born: occurs as ophthalmia neonatorum, due to vaginal infection of conjunctiva. Amenable to early treatment, but neglected cases are a common cause of blindness. In infants and children: as vulvovaginitis from accidental infections by sponges, etc. In adults: spreads by sexual intercourse with infected individuals.

Bacteriology.—Gonococcus was isolated by Neisser in 1889.

PRINCIPAL CHARACTERISTICS ARE: (i) Diplococcus, bean-shaped with flat sides almost in apposition; (ii) Gram-negative, but stains with ordinary stains; (iii) In pus and body-fluids mainly intracellular; (iv) Characteristically present only in a few cells amongst many, such cells each containing a large number of cocci; (v) Grows best on blood-agar and media containing serum or blood. Growth is delicate: does not grow on agar and many ordinary media: cultures die rapidly, especially initial cultures. Life outside body-tissues and media is very short.

Clinical Conditions in Adults.—(i) **PRIMARY LESION** in man is a urethritis, in woman a cervicitis and urethritis. (ii) **DIRECT SPREAD** may occur to prostate, epididymis, Fallopian tubes, ovaries, and even through this route to peritoneum. In males gonorrhœal peritonitis is extremely rare. Proctitis is not uncommon in females. *Conjunctivitis* is not very common. (iii) **SYSTEMIC INFECTIONS** occur in a small proportion of cases. Although gonococcus is not commonly isolated, local lesions are due probably to presence of organisms, and not to toxins absorbed from a distant focus. Systemic infections may be:—

1. **SEPTICÆMIA.**—Rare: organism sometimes isolated from blood. Clinical types: (i) General septicæmia, condition may resemble typhoid; (ii) Pyæmic abscesses; (iii) Gonorrhœal

puerperal septicæmia; (iv) Infective endocarditis and pericarditis: very rare. Fatal termination is rare, except in infective endocarditis.

2. GONORRHOËAL ARTHRITIS.—

TIME OF ONSET.—Usually within few weeks or months of initial urethritis, but may be later when gleet is chronic. In rare cases follows the vulvovaginitis of infants and ophthalmia neonatorum.

SEX.—More common in males.

MORBID ANATOMY.—Changes mainly in *peri-articular tissues*, œdematous swelling and infiltration. Synovial membrane hyperæmic and joint may contain increased and turbid fluid: polynuclear cells often numerous but suppuration rare. In chronic stages, peri-articular tissues thickened, but bony changes rare. Gonococci may be present in fluid: usually absent. Mixed infections very rare.

JOINTS AFFECTED.—*Knee* especially frequent. *Usually more than one joint. Large joints most common. Temporomaxillary* and, rarely, sternoclavicular and sacro-iliac joints may be affected. (These escape in acute rheumatism.)

PHYSICAL SIGNS.—Variable. May be stiffness and vague pain, without swelling, or with synovial effusion. More typically, red, hot, and tender, with *peri-articular swelling*, with or without much effusion. *Suppuration rare*. Mixed infections very rare.

CLINICAL COURSE.—Duration of joint affection several weeks: as one clears, another often becomes affected. Often very obstinate. Rapid shifting, as in acute rheumatism, does not occur.

COMPLICATIONS, SEQUELÆ, AND VARIATIONS IN LESIONS.—The peri-articular tissues are especially affected, and spread may occur along the tendons. Gonorrhœa tends also to attack fibrous tissue. The following are important:—

1. *Fibrous Adhesions.*—Commonly form round affected joint, in absence of suitable treatment. Cause contractions and limitation of movement. Bony ankylosis rare.
2. *Flat-foot.*—Common sequel when foot and ankle affected. Caused by yielding of ligaments and plantar fasciæ.
3. *Tenosynovitis.*—Joint may be unaffected. Tendo Achillis most frequent site.
4. *Bursitis.*
5. *Painful Heels.*—Pain in os calcis on walking: probably periostitis of os calcis, or certain plantar fasciæ affected.

CONDITIONS SOMETIMES GONORRHOËAL.—

Sciatica.—May be true sciatic neuritis or neuralgic pains. Neuritis of other nerves occurs occasionally.

Spondylitis Deformans (q.v.).

Acute Myositis.—Painful muscles: usually, but not always, near an affected joint.

Gonococcus Infections—Arthritis, continued.

DIAGNOSIS.—Initial lesion usually makes diagnosis easy in males. Important symptoms are involvement of unusual joints, peri-articular thickening, obstinate nature, slight fever, and uselessness of salicylates.

Diagnosis especially from acute rheumatic fever, arthritis deformans, and gout.

PROGNOSIS.—Condition obstinate, but prognosis good. Recurrences frequent.

TREATMENT.—

Primary Lesion.—This must be thoroughly treated.

Local Treatment.—Complete rest on splint, but with *massage and passive movements* from early stage in order to prevent adhesions. Paint with iodine. Aspirate if joint very distended. If suppuration occurs, incise and drain. When adhesions are present, break down by careful movements under anæsthesia.

Drugs and antiserum are useless.

Vaccine treatment should be tried in obstinate cases. Dose may commence with 5 million, weekly injections with increasing amounts. Very large injections (500 million) have been given without ill effects.

CHAPTER X.**DYSENTERY.**

Dysentery is characterized clinically by: (1) Passage of frequent small stools; (2) Presence of mucus and blood; (3) Abdominal pain and tenesmus. These symptoms constitute dysentery when due to certain specific causes. The symptoms are the result of an *inflammatory or ulcerative colitis*, a condition which may also arise from causes and organisms not at present recognized as dysentery.

Types.—Dysentery is of two main types: (1) **BACILLARY**, due to certain specific bacilli; (2) **AMÆBIC**, due to protozoon *Entamæba histolytica* (considered here for convenience).

The term 'dysentery' is used now to imply the presence of one of these two groups of organisms, however mild the symptoms may be, and its definition is etiological rather than clinical. Either may cause a simple diarrhœa without the characteristic symptoms. Extensive epidemics are usually bacillary dysentery, and, when the death-rate is high, are generally due to Shiga's bacillus.

I. BACILLARY DYSENTERY.

Bacteriology.—Two principal groups of bacilli: (1) *Shiga* or *Shiga-Kruse*. Isolated by Shiga in 1898. (2) *Flexner*. Numerous strains, at least five, exist in this group, and are identified serologically as V, W, X, Y, Z. Shiga's group is much purer. (For *Sonne's* bacillus, see p. 95.)

MORPHOLOGY.—Non-motile, non-sporing, Gram-negative bacilli resembling coli-typhoid group. (Motility and flagella have been described in some strains.) Grow readily on ordinary media. Growth resembles typhoid, but is moister and more slimy.

CULTURAL CHARACTERS:—

LITMUS MILK.—Slight initial acidity, then alkaline. Never clotted.

CARBOHYDRATES.—No gas formed by any strain, and all are non-lactose fermenters.

SHIGA.—Acidifies dextrose only.

FLEXNER.—Acidifies dextrose and mannite; some strains, also maltose.

INDOLE.—Produced by Flexner but not by Shiga.

PATHOGENICITY TO ANIMALS.—Intraperitoneal injections are pathogenic to guinea-pigs, rabbits, and other animals. Death occurs in a few days: hyperæmia and catarrh of the intestines are present, but the characteristic changes of dysentery are produced only by special methods.

Modes of Infection.—Resemble enteric, viz., by water, food, flies, and contamination by excreta of infected persons.

Morbid Anatomy.—The large intestine is mainly affected. The entire colon may be equally involved, but frequently the maximum change is in the sigmoid, extending above and below with diminishing severity. The ileum is frequently hyperæmic for a varying distance.

In acute, rapidly fatal cases, the mucous membrane is hyperæmic, dark red, and thickened: there is superficial necrosis, but usually no ulceration: may be bile-stained.

In less acute forms, changes consist of: (1) *Ulceration*: commences in the lymphoid follicles, numerous small superficial ulcers forming. The edges may be thickened and infiltrated, but are never undermined (as occurs in amœbic dysentery). Destroyed mucous membrane is characteristically green. (2) *Thickening of the mucous membrane*: in chronic cases may be nearly $\frac{1}{2}$ inch thick: most marked on summits of folds, on which in extreme instances polypoid masses may form. In severe chronic cases the ulceration may affect most of the intestine, a few islets of thickened mucous membrane remaining.

Peritoneal adhesions may form.

Mesenteric glands are not uncommonly enlarged.

Symptoms.—

INCUBATION PERIOD.—May be a few hours only, and probably rarely exceeds three days. Occasionally up to eight days.

ONSET.—Sudden. Characteristic symptoms usually present from the first; the occurrence of a simple diarrhoea at onset being unusual.

SYMPTOMS AT ONSET.—

FREQUENT SMALL STOOLS.—May be almost continuous.

ABDOMINAL PAIN.—Tormina and tenesmus. Between stools, there may be little pain.

Bacillary Dysentery—Symptoms, *continued*.

CHARACTER OF STOOLS.—Each motion of small quantity.

A few initial stools may empty the intestine of faecal matter.

Subsequently: red-blood-tinged mucus in mass ('red-current jelly'), or clear mucus and blood. Alkaline. *Microscopic*: numerous pus cells; red cells; large macrophages (to be distinguished from amœbæ); bacilli scanty. *Entamœba coli* common.

VOMITING.—Common at onset: may be for one to two days.

HEADACHE.—Usual.

TEMPERATURE.—Variable: high, low, or moderate.

PULSE.—Rapid.

BLOOD-COUNT.—No change.

PROGRESS.—Generally rapid, and within one to two days can be divided into (a) Severe, (b) Moderate.

a. SEVERE FORMS.—Complaints of (i) abdominal pain, (ii) thirst. On examination, dryness and coldness are marked.

Stools. Very numerous. Almost pure blood, with varying amount of mucus. Desire for stool almost continuous.

Skin. Dry and inelastic. A bluish flush on cheeks, of limited area, is common. *Extremities* cold.

Abdomen. Retracted. *Rigidity* is unusual. *Tenderness* often extreme, especially on left side, but on palpation contraction of muscles usually does not occur. Pain preceding and accompanying stools, but may be only slight between motions.

Tongue dry. *Fur* variable, may be absent.

Temperature. No characteristic: usually high, 103°, or subnormal. *Pulse* rapid and small.

Vomiting not infrequent, and a very serious symptom when occurring at this stage. Also *hiccup*.

Muscular pains not uncommon: especially anterior thigh and calves. Also in knees and joints.

Subsequent progress.—(1) Symptoms more severe. Prostration increases. Discomfort extreme. Incontinence of urine and faeces. Mental wandering common, but mind may remain clear. Progressive failure and death. (2) Slow gradual improvement. Convalescence prolonged. Rapid recovery does not occur. *Mortality* in severe forms over 50 per cent.

b. MODERATE FORMS.—Not necessarily mild, and abdominal pain and thirst may be severe, but dryness and coldness not marked.

Stools. May be very frequent, up to 15 or 20 daily, but not pure blood.

Skin moist.

Abdomen. Rarely retracted. *Rigidity* not uncommon, and contraction of muscles occurs on palpation at sites of tenderness. Sigmoid often palpable, contracted in spasm.

Tongue. Moist fur, or may be clean. *Pulse* rapid but not running. *Temperature* variable. *Vomiting* very rare.

Subsequent Progress.—Acute stage, four to five days. Rapid improvement in succeeding five days. Progress subsequently varies: may continue to improve rapidly, or drift into subacute and chronic types.

Mortality low.

NOTES ON SYMPTOMS.—

TEMPERATURE.—Not of great assistance. (a) *Severe forms*: commonly high at onset, but usually subnormal when condition has developed. (b) *Moderate forms*: temperature is some measure of severity. High temperature is a sign of severe infection, especially when persistent. Fall of temperature is a sign of improvement. Milder cases have slight pyrexia.

VOMITING.—Occasional vomiting at onset is common and of little importance. Persistence or onset of vomiting later is serious symptom.

SWEATING.—A sweating patient is rarely in immediate danger.

MILD FORMS.—Symptoms of any degree of mildness may result from infections with dysentery bacilli; condition often indistinguishable clinically from a simple transient diarrhoea.

Complications and Sequelæ.—

COLITIS.—Constipation, or alternating periods of diarrhoea and constipation, very common sequel. *Chronic colitis* may be a permanent sequel. Appendicitis is rare.

ARTHRITIS.—Onset usually during convalescence. Large joints, especially knees, affected. May occur in mild cases. Considerable effusion: fluid contains polynuclear leucocytes. *Complete recovery is almost invariable and suppuration never occurs*, but duration may be months. Heart unaffected.

IRITIS AND IRIDOCYCLITIS.—Especially with arthritis.

BOILS.—Occasionally troublesome.

HÆMORRHOIDS.—Occurrence common. Not uncommon cause of much blood in stools during convalescence.

PERITONITIS.—Perforation occurs rarely. In later stages and after severe attacks only. Peritonitis may be general or localized by adhesions. Perforation often multiple. Death-rate very high.

CICATRICAL CONTRACTIONS.—May cause intestinal obstruction. Rare.

TACHYCARDIA and various forms of disordered action of the heart develop occasionally.

PULSE-RATE IN CONVALESCENCE.—Bradycardia, 40 to 60, is not uncommon in 2nd to 4th weeks, especially in milder forms. Pulse-rate of 60 to 70 usual after more severe infections. About the 4th week, pulse-rate often increases to 100 or more rapid, as the patient gets up.

MALARIA.—If latent, may become active.

Bacillary Dysentery, continued.

Convalescence.—After severe attacks, convalescence is very slow: many months. With moderate attacks, chills and dietetic errors rapidly cause intestinal disturbances. Dyspepsia and gastric discomfort common. Constipation frequent.

Diagnosis.—*Diarrhoea of any form, mildness, or severity, may result from infections with dysentery bacilli; but in epidemics characteristic cases will occur. The ultimate diagnosis depends on specific methods.*

DIAGNOSIS FROM NON-DYSENTERIC CONDITIONS.—

1. **ENTERIC.**—Onset rarely acute. Mucus in stools unusual. Agglutination reactions and bacteriology.
2. **FOOD-POISONING.**—Characterized by simultaneous affection of many individuals. Condition is mainly ileitis or enteritis, and blood is unusual after initial severe motions, and mucus not prominent.
3. **ACUTE ULCERATIVE COLITIS.**—Now generally accepted that all forms are of bacillary origin. Indistinguishable clinically and pathologically from dysentery.
4. **MALARIA.**—‘Malarial dysentery’ is usually but not invariably true dysentery.

DIAGNOSIS FROM AMŒBIC DYSENTERY.—

		BACILLARY.	AMŒBIC.
Onset	.. ..	Acute.	Often more gradual: initial diarrhoea not uncommon.
Progress	.. ..	Most severe at onset.	Irregular. Tends to be chronic.
Stools.—Often indistinguishable, but characteristically:		Single mass of glairy mucus, untinged by blood. Pus cells and blood present. Motions when formed are coated with mucus.	Mucus, blood and faecal matter more intimately mixed. Small masses of blood-tinged mucus. Motions when formed are mixed with mucus.
Complications	.. ..	.. ..	Hepatic abscess.
Morbid Anatomy	.. ..	Sigmoid most affected. Ileum often hyperæmic. Ulceration superficial. Mucous membrane thickened.	Cæcum and ascending colon mainly. Ileum rarely affected. Ulcers with undermined edges.

SPECIAL METHODS OF DIAGNOSIS.—

1. **EXAMINATION OF STOOLS.**—Examine for bacilli and also for amœbæ and amœbic cysts (*see p. 92*). Stools must be fresh. In later stages culture from rectal swabs.
2. **AGGLUTINATION.**—Agglutinins usually appear early, by 2nd day, and usually maximum by 6th day. (1) *Shiga infections*: Agglutination often definite, ‘positive’ if in dilution 1–50. (2) *Flexner infections*: Agglutination complicated by multiplicity of strains; also by tendency of normal sera to agglutinate these bacilli. Agglutinins are usually transient.
3. **SIGMOIDOSCOPY.**—In chronic cases. Mucous membrane replaced by areas of granulation tissue surrounded by hyperæmia.

Prognosis.—*In severe forms*, as described above, mortality very high: 40 to 60 per cent. *In moderate forms*, mortality usually very low. The relative frequency of these two forms varies greatly with the causal bacillus. (a) *Shiga infections*: Severity is common, and convalescence prolonged even in milder forms; but simple diarrhoea may result from Shiga infections. (b) *Flexner group*: In Europe, mortality from these infections during European War did not exceed 2 to 3 per cent.

Treatment.—

1. **GENERAL TREATMENT.**—The first essentials are *warmth and fluid*. If patient restless, wrap arms in cotton-wool and give extra shirt. *Water by mouth*: boiled water, $\bar{3}j$ every quarter to half hour. *Intravenous saline* with 5 per cent glucose if collapsed. For abdominal pain: turpentine stupe, hot-water bottle. Mouth wash: frequently.
2. **DIET.**—Small amounts: frequently (two to three hours): not hot but without chill.

IN SEVERE FORMS.—Fluids only. Whey, chicken-broth. White-wine whey. Milk not well taken.

IN OTHER FORMS.—Semi-fluids from onset or after one to two days. Beef-tea or chicken-broth, custards, egg-flip, rice milk, occasional milk foods.

PROGRESS.—As improvement occurs, amount of diet may be increased, but semi-fluid diet should be maintained until, for seven days, motions have not exceeded two daily and no visible blood or mucus is present. Proceed with boiled fish and then chicken.

3. **MEDICINAL TREATMENT.**—

SALINE.—Sodium sulphate, $\bar{3}j$, two-hourly for first day. Subsequently four-hourly and six-hourly for four to five days. Stools often improve rapidly and tenesmus is eased. The method aims at emptying the intestine. To be employed *only at onset of attack*, and is contra-indicated by numerous previous motions and in severe forms.

When seen early, an initial dose of sodium sulphate $\bar{3}ss$ or castor oil may be given.

ENEMATA.—Starch and opium enemata. Colonic washes. Medicated enemata. For details, *see* ULCERATIVE COLITIS: but in dysentery improvement is more rapid.

DRUGS by the mouth have little effect. Mist. cretæ (B.P.) $\bar{3}j$, two- or four-hourly. Bismuth salicylate gr. xx, t.d.s. **MORPHIA.**—Should only be given as last resort for extreme restlessness and insomnia. In general is *contra-indicated*.

ALCOHOL.—Usually disliked and may cause vomiting.

EMETINE.—Contra-indicated. Valueless in bacillary dysentery, and is an intestinal irritant.

4. **SERUM TREATMENT.**—To be given in all severe cases, but of little value except at onset. Inject 40 to 80 c.c. subcutaneously, or in severe cases intravenously (diluted with saline). A polyvalent serum must be used unless type of bacillus is known. *Serum reactions* are often severe.

Bacteriophage is of no value.

Bacillary Dysentery—Treatment, *continued*.

CONVALESCENCE.—

GASTRIC DISTURBANCES AND DIARRHŒA.—Modify diet, especially meat.

CONSTIPATION.—Liquid paraffin 3ij, t.d.s., with simple enemata, e.g., salt and water (3j to the pint). Avoid aperients, saline or vegetable; moderate constipation preferable.

DIARRHŒA.—See COLITIS.

Prophylaxis.—General methods should be directed against modes of infection as in typhoid fever.

'DYSENTERY CARRIERS'.—Carriers of bacillary dysentery are very rare after twelve months from the attack. Usually diagnosed by agglutination.

INOCULATION.—Reactions to dysentery vaccines have proved too severe for practice.

II. AMŒBIC DYSENTERY.

Amœbic dysentery is caused by infection with the protozoon *Entamœba histolytica*.

The Amœba.—

ENTAMŒBA HISTOLYTICA.—General characteristics:—

1. Size: 15 to 50 μ diameter, commonly about 30 μ .
2. Clear refractile ectosarc with a granular vacuolated endosarc.
3. Amœboid movements active. Clear pseudopodia are thrown out and retracted.
4. Often contains red cells.
5. Nucleus indistinct and eccentric.

Cysts.—

- i. Size: 7 to 14 μ diameter. Round.
- ii. Nuclei: 2 or 4 in number.
- iii. Chromidial body present.
- iv. Cyst wall thin and indistinct.

ENTAMŒBA COLI.—Size about same as, or rather larger than, *histolytica*. Distinction often extremely difficult, depending on (i) absence of ectosarc, (ii) amœboid movements sluggish, (iii) red cells rare and never numerous, (iv) nucleus central and more distinct.

CYSTS.—Distinction from *histolytica* depends upon:—

- i. Size: diameter 15 to 20 μ : sometimes 30 μ . (Smaller cysts may occur; also *histolytica* are occasionally larger than 14 μ .)
- ii. Nuclei: 6 or 8, sometimes more. Simplest and most reliable mode of distinction.
- iii. No chromidial body.
- iv. Cyst wall more distinct.

ENTAMŒBA NANA (*Endolimax nana*).—A small (6 to 12 μ), non-pathogenic amœba. The cysts are same size as *histolytica*, and contain 1, 2, or 4 nuclei, but are of oval shape.

PRESENCE OF ENTAMŒBA HISTOLYTICA IN STOOLS.—*Vegetative forms* in acute stages only. Stool must be examined immediately, as amœbæ rapidly disappear. Examine unstained

or with a little weak neutral red, preferably on a warm stage. *Cysts*: Pick out portion of mucus: place on slide with Lugol's iodine solution; this renders nuclei more distinct and also stains glycogen granules. Examine slide with a $\frac{1}{4}$ lens and confirm with oil-immersion lens.

MODES OF SPREAD.—*Active forms* of amœbæ die very rapidly even in fæces. *Cysts* have long endurance in moisture, fæces, and water, but are rapidly killed by drying. Spread of disease is probably entirely by cysts, from presence in stools and frequency of 'carriers'. Epidemics mainly water-borne. Cooks, if 'carriers', infect food. Flies may transmit by feeding on fæces and subsequently defæcating on food.

Morbid Anatomy.—*Cæcum* and *ascending colon* are usually most affected. The entire large intestine may be involved: less often sigmoid and rectum. The ileum escapes.

ESSENTIAL CHANGES.—(a) *Thickening of the wall*, mainly of the submucosa, by œdema and round-cell infiltration; (b) *Ulceration*, occurring in thickened areas. The entire large intestine may be studded with ulcers, intervening areas of mucous membrane but little affected being practically always present. Amœbæ enter mucous membrane through crypts of Lieberkühn, and mainly affect and spread in the submucosa.

INFILTRATION OF SUBMUCOSA.—Earliest stage due to œdema, multiplication of fixed cells, and round-cell infiltration. Polynuclear leucocytes are scanty at all stages. *Prominences* appear on gut, size of pea.

MUCOUS MEMBRANE over prominences necroses and sloughs, forming *ulcers* with irregular outline, ragged and characteristically *undermined edges*. Floor often has black tenacious slough. In submucosa undermining of the mucous membrane is essential feature. Amœbæ are in the spreading edge.

HEALING results by formation of fibrous tissue. Hence local contractions may result, but not a stricture.

All stages of ulceration and repair may be present simultaneously in the same specimen.

IN CHRONIC CASES.—Wall thick in some parts, in others thin, scarred, and pigmented. Cicatricial contractions and peritoneal adhesions may be present.

PERFORATION AND PERITONITIS may occur.

LYMPHATIC GLANDS.—Usually enlarged.

LIVER ABSCESS.—Occurs in 2 per cent of cases. (See ABSCESS OF THE LIVER.)

Symptoms.—

INCUBATION PERIOD.—Probably 3 weeks to 3 months.

ACUTE FORM.—Not common. Onset sudden, but often previous diarrhœa. Symptoms in general resemble bacillary dysentery, but less tenesmus and toxæmia, and usually afebrile.

CHRONIC FORMS.—Common. Onset insidious. Characterized by irregularity, intermissions, and relapses. Attacks may be mild or

stages, and a course should always be given, and followed by emetine-bismuth-iodide.

EMETINE-BISMUTH-IODIDE.—More effective remedy in treatment of carriers. Dosage: gr. iij daily for 12 days, by the mouth, in gelatin capsules. If relapse occurs, give a second course for twenty-four days. Best given in a single dose at night, and patient told to lie still.

Improvement in acute cases is very rapid under emetine treatment, and mortality low.

YATREN (Bayer).—Also known as quinoxyl and chiniofon. Authorities differ as to value. Given: (1) By mouth: pill gr. iv, four daily. (2) By enema: 2.5 per cent solution, 200 c.c., after colonic wash; retain 10 hours.

RIVANOL, **STOVARISOL**, and other drugs are under trial.

VARIOUS INTESTINAL INFECTIONS.

'*Sonne*' *Dysentery due to Sonne's Bacillus.*—*Bacillus* differs from *Shiga-Flexner* thus: (1) Not agglutinated by *Shiga-Flexner* sera; (2) Ferments lactose slowly (cultural characteristics very variable). *Symptoms*: Ileocolitis. Usually mild, prolonged or intermittent diarrhoea with green motions. Rarely acute, with vomiting, diarrhoea, and rapid collapse; may be fatal. *Bacillus* recorded in most countries, but frequency uncertain.

*Lambli*a (or *Giardia*) *intestinalis.*—A flagellate protozoon, which inhabits the duodenum and jejunum. Pyriform in shape, with a characteristic saucer-shaped depression and four pairs of flagella: length about 20 μ . Encysted non-flagellated form also occurs. May occur (often in enormous numbers) in a diarrhoea of enteric type with large yellowish stools. Never causes dysenteric symptoms. Bismuth salicylate procures temporary absence.

Trichomonas intestinalis. *Tetramitus mesnili*. *Balantidium coli* or *Paramaecium coli.*—No proof of pathogenicity.

CHAPTER XI.

UNDULANT FEVERS.

(*Brucellosis. Malta Fever.*)

Specific infectious fevers caused by strains of the *Brucella* group of organisms, and characterized by a series of pyrexial attacks with sweats, muscular pains, arthritis, and enlarged spleen.

Described under headings: (I) Undulant Fever, *Melitensis* Type; (II) Undulant Fever, *Abortus* Type.

Brucella Group of Organisms.—Bruce, 1887, discovered causal organism of Malta fever, considered to be a coccus, and named *Micrococcus melitensis*. Bang, 1896, isolated organism of contagious abortion of cattle, considered to be a bacillus, and named *Bacillus abortus*. All group markedly pleomorphic and may be

Undulant Fevers—*Brucella* Group of Organisms, *continued*.

described as cocco-bacilli. Evans, 1918, discovered these two organisms to be almost identical serologically. Subsequently human infections recognized to be widespread in temperate climates, often with ill-defined clinical features.

MAIN VARIETIES.—

1. *Brucella melitensis* (*Micrococcus melitensis*).—Parasite of goats: conveyed by goat's milk: organism of Malta fever.
2. *Brucella paramelitensis*.—Allied strain found in Tunis and Algeria.
3. *Brucella abortus* (*Bacillus abortus*).—Parasite of cow, causing abortion: conveyed by milk. *Brucella suis*: allied strain in pigs.

B. tularensis possibly belongs to the group.

Antiserum of each organism agglutinates others of group, but titre in general is not identical.

I. UNDULANT FEVER, MELITENSIS TYPE.

Geographical Distribution.—Widespread throughout world in goat-rearing districts of tropics and subtropics.

Bacteriology (applies to *Brucella* group).—

MORPHOLOGY.—Minute cocco-bacillus; markedly pleomorphic; occurs singly, in pairs, or (in cultures) in short chains. Non-motile. Stains with ordinary stains. *Gram-negative*.

CULTURAL CHARACTERISTICS.—Grows on ordinary media, but colonies not visible before third day, often much later: anærobic culture may be necessary.

OCCURRENCE IN HUMAN BODY.—Numerous in spleen: can be isolated at autopsy. Present in blood during attack. Excreted in urine after fifteenth day in 10 per cent of cases, usually for many weeks or months.

AGGLUTINATION REACTION.—Agglutinins appear in second week; persist through course, often in high titres. In *abortus* infections especially, special care is necessary: use several strains and in many dilutions, owing to zone reactions. Agglutinins remain for long periods: titres about 1-50 indicate past infection; titres over 1-100, in presence of pyrexia, indicate present infection.

Mode of Infection.—Through goat's milk. In Malta in 1904, 10 per cent of goats infected: may appear healthy, but often thin. Monkeys and other animals readily infected. Laboratory infections common. One attack apparently confers immunity.

Morbid Anatomy.—*Spleen* weighs about 1 lb., soft and congested. No other characteristic changes. Alimentary tract nil.

Symptoms.—The condition is a septicæmia, characterized by irregular undulations of temperature.

INCUBATION PERIOD.—Usually about fifteen days, but limits uncertain, at least six to twenty days.

EARLY SYMPTOMS.—Malaise, often pain in eyes and jaws, muscular pains, and gastric disturbances. May be ambulatory for several weeks.

CHARACTERISTIC ATTACK.—*Period of fever* with symptoms lasting one to three weeks. *Period of defervescence* follows: may be slight pyrexia or normal temperature and convalescence from ten to twelve days. *Relapse* occurs for shorter period. *Longer apyrexial period*, which may be again followed by yet milder relapse. Number of undulations variable, often three in mild case: may be numerous. *Duration*: very variable and course erratic; often three to six months, but may be more prolonged, two years.

MODERATE ATTACK OR FIRST UNDULATION.—(1) *Pyrexia*, 102° to 104° or 105° , typically step-like rise and fall, but may be markedly irregular or even intermittent. (2) *Gastric disturbance*. Constipation obstinate. Nausea and vomiting not infrequent. Diarrhoea occasionally. (3) *Profuse sweats*. (4) *Muscular pains*. (5) *Headache*, restlessness. (6) *Spleen* enlarged and tender.

SEVERER SYMPTOMS.—Occur more frequently during relapses. (a) *Headache* severe. (b) *Arthritis*: may be large effusion. Tends to be transient, but reappears in other joints. No redness. Pains may be agonizing. (c) *Neuralgia* pains and sciatica. (d) *Fibrositis*. Especially round ankle-joint. (e) *Anæmia*: progressive. (f) *Insomnia*.

OTHER SYMPTOMS.—Rashes rare: erythema, rarely purpura. Bronchitis and lung affections occur in late stage. Orchitis and epididymitis rare but painful.

Progress.—When relapses are numerous, great debility and mental depression develop, with anæmia and tachycardia.

Varieties.—(1) **AMBULATORY FORM**: Evening pyrexia and slight malaise: recognized in Malta. (2) **INTERMITTENT FORM**: Daily variations of temperature, with chills followed by sweats. May suggest malaria. (3) **MALIGNANT FORM**: Fatal in one to two weeks. Typhoidal state develops. Very rare.

Diagnosis.—Often difficult clinically, specially from enteric.

CULTURES.—Blood cultures positive in early stages only. In urine longer duration: also in fæces: isolation difficult.

AGGLUTINATION REACTION.—*See above*.

BLOOD COUNT.—Leucopenia with relative lymphocytosis.

SPLEEN CULTURE (to be performed with caution).

Intradermal test of doubtful value.

Prognosis.—Mortality low, 2 per cent.

Treatment.—*General Treatment* as in typhoid fever. No specific treatment exists. Quinine and salicylates of no effect. Protein shock occasionally aborts pyrexia—viz., *intravenous* injection of 20 million T.A.B. vaccine.

Undulant Fevers, *continued*.

II. UNDULANT FEVER, ABORTUS TYPE.

General Features.—

1. Human *Brucella abortus* infections are spread over most of the world.
2. In the British Isles 80 per cent of milch herds are infected with *Brucella abortus*, and 40 per cent of raw milk is infected.
3. Pasteurization of milk, properly carried out, kills *Brucella abortus* and renders milk safe for consumption, but does not destroy the agglutinins in milk.
4. Human infections are due to : (a) Consumption of infected milk ; (b) Contiguity to infected animals, cattle and pigs, especially applying to slaughtermen, farm labourers, and veterinarians.
5. Clinical symptoms develop in only a small proportion of those drinking infected milk, but high proportion of mild or latent infections is revealed by frequency with which healthy sera agglutinate with *Brucella abortus* in low dilutions, e.g., 1-40.
6. There is evidence that *Brucella abortus* has caused abortion in human beings.

Clinical Manifestations.—No essential distinction from *melitensis* infections. Tends to be milder, pyrexia irregular or continuous and less often undulant, arthritis less marked. May be long ambulatory period.

CHAPTER XII.

CHOLERA ASIATICA.

An acute infective disease due to presence of the cholera vibrio in alimentary tract, and characterized by purging, muscular cramps, and rapid collapse. Infection is usually water-borne.

Etiology.—

CLIMATE.—Endemic and epidemic in tropics. Prevalence greatest in India. In temperate zones occurs as epidemics, but never endemic.

SEASON.—Favoured by hot weather in temperate zones, especially in early autumn.

AGE.—All ages affected. One attack does not confer immunity.

Bacteriology.—Organism discovered by Koch in 1883 in outbreak in Egypt, known as *cholera vibrio*, *cholera spirillum*, or *comma bacillus*. Fulfils Koch's postulates.

MORPHOLOGY.—Small, motile, curved rods, about 2 μ long. In cultures mostly singly, but two may join together like an S. A single terminal flagellum is usually present, but in some varieties may be two, as in Massonah strain. Correctly it is a spirillum, and in liquid media growth tends to spirillar forms. The short forms are called vibrios. In old cultures numerous involution

forms are seen; many are circular but are not spores. *Gram-negative*, but stains with ordinary stains, preferably weak carbol-fuchsin, one part to four of water.

CULTURAL CHARACTERISTICS.—Grows on all ordinary media. Characteristic are :—

1. **GELATIN STAB.**—On 5th day air-bubble on surface, with funnel of liquefaction below.
2. **GELATIN PLATES.**—Colonies have granular surface with irregular outline like fragments of broken glass. Later, medium liquefies, with appearance of concentric rings.
3. **CHOLERA RED REACTION.**—Growth in broth forms both indole and nitrite. Addition of pure sulphuric acid gives a pink colour from nitroso-indole. The culture must be 8 days old. Reaction increases up to 2 or 3 days. Not all broth preparations give reaction. Sulphuric acid used must be free from nitrites.

On broth growth forms a surface pellicle. In milk grows well without apparent change in medium.

BACTERIOLOGICAL DIAGNOSIS.—

1. Prepare a film from the stools and stain with weak carbol-fuchsin. Organisms may be present in large numbers.
2. Inoculate broth with loopful of stools. Incubate for two hours, and subculture into media as described under cultural characteristics.
3. *Agglutination of cultures* with specific cholera antiserum. Essential for identification.

DISTRIBUTION IN THE BODY.—Essentially in the intestines, especially small gut. Vibrios do not penetrate deep in mucosa. Occasionally in gall-bladder; very rarely in other organs. Numerous in motions, especially in rice-water stools, which may contain almost pure culture. Symptoms probably due to absorption of toxins. In preparations from stools, organisms tend to lie with long axes parallel, 'like fish in a stream'.

RESISTANCE.—Life in ordinary drinking water very variable, and depends partly on the temperature and amount of organic matter present. Varies from a few days to three weeks. Can multiply in water. *Drying* kills in a few minutes. Can live several weeks on moist linen. In stools, rapidly overgrown by bacilli.

AGGLUTININS, ANTISERA.—*Agglutinins* appear in blood eight to ten days after onset, and reach maximum in two to four weeks, agglutinating cholera vibrio in high dilution. Consequently of no value for *immediate diagnosis*, but agglutination is usually positive in cholera carriers.

Antisera have been prepared. No obvious value in treatment.

ANTI-CHOLERA INOCULATION.—

HAFFKINE'S VACCINE.—Must be repeated every 5 months. No reaction occurs. Incidence among inoculated is low: case-mortality is less influenced. Inject 12,000 to 15,000 million bacilli: two inoculations at intervals of 7 to 10 days.

BESREDKA'S ORAL VACCINE.—Widely used in Russia: good results reported.

Cholera Asiatica, continued.

Mode of Infection.—Is essentially water-borne, and all large epidemics are spread thus. Infection may be due to: (i) *Water*. Drinking water undoubtedly most common factor. Also by vegetables, etc., washed in infected water. (ii) *Cholera carriers*. Virulent vibrios may be present in the motions of clinically healthy persons. *Food* may be thus infected by cooks, or water supply affected. Usually transient, 1 to 2 weeks, rarely 2 months. Vibrios in fæces of patients rarely longer than 3 weeks, frequently only a few days. (iii) *Flies* may carry infection to food. *Direct contagion negligible*. Doctors and nurses rarely affected. Is not air-borne.

Duration of Infectivity.—Vibrios are rarely passed for more than 2 or 3 weeks after an attack, and usually not more than one week.

Quarantine Period.—Seven days.

Symptoms.—

INCUBATION PERIOD.—One to 3 or 4 days or up to 7 days. May be premonitory diarrhœa and malaise.

Clinical course usually described in three stages: (1) Stage of evacuation; (2) Stage of collapse (algid stage); (3) Stage of reaction.

STAGE OF EVACUATION.—*Onset abrupt*: (i) *Severe purging*, followed rapidly by (ii) *Vomiting*—often becomes incessant, (iii) *Muscular cramps*, especially in legs; may be agonizing. (iv) *Progressive exhaustion*. (v) *Thirst* becomes extreme. *Stools* at first yellow, rapidly become white, so-called rice-water stools. When frequent, usually odourless. *Tenesmus* usually absent. *Temperature* generally subnormal. *Pulse* feeble. Exhaustion and collapse increase. Consciousness retained. Recovery may now commence, or more advanced collapse follow.

STAGE OF COLLAPSE. ALGID STAGE.—*Collapse extreme*, face pinched, eyes sunken, skin wrinkled, restlessness, cyanosis, clammy perspiration, semi-consciousness or coma. Involuntary passage of watery motions; may be anuria. *Temperature* subnormal; may be high in rectum. *Pulse* rapid, may be impalpable. *Duration*, from two or three to twenty-four hours. *Mortality* very high. The collapse is due to withdrawal of fluid from the blood, resulting in concentration; the specific gravity of the blood rises to 1060 and may reach 1072 or 1078 (normal 1058). Blood thick. Pressure low, 70 mm. or under.

STAGE OF REACTION.—In favourable cases with or without algid stage. Rapid improvement. Consciousness returns. Skin becomes warm. Bile appears in motions. Stools become less frequent. Usually some fever. Erythema common.

CHOLERA TYPHOID.—Stage of reaction may be incomplete, and a typhoidal condition develop, usually with anuria. Common towards end of first week in severe cases. High mortality.

CONVALESCENCE.—Usually rapid. Complications arising may be: *Recrudescences*, frequent and often fatal; *Erythema* and numerous forms of skin eruptions, may be hæmorrhagic.

SEQUELÆ.—Unusual, recovery generally complete: (1) *Nephritis*. (2) *Cramps in muscles*. (3) Diphtheritic inflammations of mucous membrane of intestine, fauces, and genitals. (4) Various results of weakness: (a) *Psychical*, e.g., *insomnia*; (b) Tendency to boils, *pneumonia*, etc.

TYPES.—All grades of severity occur. *Ambulatory* cases without symptoms constitute 'carriers'. In mild types or *cholera*, collapse slight but vibrios present in dejecta. In most severe form, *cholera sicca*, purging absent and death very rapid.

Diagnosis.—During epidemics diagnosis simple. In sporadic cases confusion may arise with: (1) Arsenic poisoning. (2) Food-poisoning; note abdominal pain, faecal stools, no suppression of urine. (3) Algid malaria. (4) Acute bacillary dysentery; note character of stools. Also fireman's cramp.

Prognosis.—Unfavourable with very rapid onset, low temperature, and especially with high specific gravity of blood, 1065 or over. Mortality formerly about 70 per cent, but greatly diminished by Rogers' method of saline infusions.

Prophylaxis.—*Preventive methods* in checking epidemics: (1) Isolation of patients and disinfection of excreta; (2) Search for 'cholera carriers'. For individuals, there are three important considerations: (i) Keep the general health good: especially attend to diet, avoiding over-ripe fruit. Treat any diarrhoea promptly. Avoid alcohol, especially on empty stomach. (ii) Boil all water and milk, and protect all food from flies. (iii) Inoculation with anti-cholera vaccine.

Treatment.—

GENERAL TREATMENT.—Rest in bed and warmth. Give water by the mouth frequently but in small amounts. Mist. cretæ (B.P.) or acid. sulphuric. dil. or kaolin. In early cases a preliminary dose of castor oil ʒj may be given. Powerful drugs to check diarrhoea must not be given, and morphia injections are contra-indicated.

DIET.—Food is of no value; give brandy, hot coffee, or ice alone by the mouth. Diet carefully in the stage of reaction to avoid relapse.

FOR THE CRAMPS.—Gentle massage and hot fomentations. When very severe, a whiff of chloroform.

CARDIAC WEAKNESS.—Injections of camphor eight-hourly (gr. ij in ℥x of sterile olive oil).

FOR ANURIA.—Fomentations to the kidneys. Normal saline per rectum frequently. Injections of pituitrin. For uræmia, sodium bicarbonate intravenously.

ROGERS' METHOD.—(1) *Hypertonic intravenous saline injections* are of highest value. Indicated in severe forms and when specific gravity of blood exceeds 1061. The formula is: sodium chloride, gr. cxx; potassium chloride, gr. vj; calcium chloride, gr. iv; water, one pint. Give at temperature 98° or lower intravenously at rate of 4 oz. a minute: one pint for each degree above 1060.

Cholera Asiatica—Treatment, continued.

This may be repeated several times at intervals of a few hours.

(2) *Potassium permanganate*, 2-gr. keratin-coated pills, every 15 minutes for 4 hours, then half-hourly until motions green. Calcium permanganate, gr. $\frac{1}{4}$ to the pint, in large draughts.

Other Species of Vibrios.—Numerous species of vibrios have been isolated in varying circumstances.

PARACHOLERA.—Strains have been isolated from stools in diarrhoea or mild cases of cholera. Distinguished from Koch's vibrio by agglutination with antisera. Mortality is very low and epidemics do not occur.

Certain strains isolated from patients with dysenteric symptoms have agglutinated with antisera to Koch's vibrio, e.g., *El Tor vibrio*. Identity or otherwise not yet certain.

METCHNIKOFF'S SPIRILLUM.—Isolated from epidemic in fowls. Pathogenic to pigeons and animals.

FINKLER-PRIOR'S SPIRILLUM.—Isolated from acute diarrhoea in children (cholera nostras). Pathogenicity not proved.

CHAPTER XIII.

PLAGUE.

A specific infective disease caused by *B. pestis* and conveyed by rat-fleas, and occurring in three clinical forms, bubonic, pneumonic, and septicæmic; of which the two former occur in vast epidemics.

Etiology.—Present cycle commenced in Hong Kong in 1894.

MODE OF SPREAD.—The principal factors are briefly as follows:

- (1) Disease primarily affects rats, and in these is always septicæmic.
- (2) Rat-fleas suck blood containing bacilli.
- (3) Rat-fleas attack man and inoculate when biting.
- (4) Spread among rats is due to rat-fleas, cannibalism, and possibly human fæces and infected food.
- (5) From rat to man, infection is solely by fleas. Infection is very rare directly from man to man. Spread of epidemic is practically entirely due to spread in rats and thence to each human being individually. (*Pulex irritans* possibly transmits direct from man to man). Drinking water apparently of no influence.
- (6) Epidemic is always preceded by epizootic in rats or, rarely, other ground animals, e.g., ground-squirrel in Californian epidemic. Outbreak in animals in a district precedes human cases by about two weeks.

Rat fleas in Tropics are *Xenopsylla cheopis*, *astia*, and *brasiliensis*: *cheopis* bites man readily, *astia* less so and not when temperature of air exceeds 80°. Prevalence of plague in a district is related to frequency of the different species. In temperate regions common rat flea is *Ceratophyllus fasciatus*: does not bite man readily. Infection is due to regurgitation by flea after feeding,

the proventriculus being blocked by mass of plague bacilli which infect blood before regurgitation.

PNEUMONIC PLAGUE forms an exception to some of above statements. Spreads directly from man to man. Bacilli present in sputum in large numbers. Spread very rapid, but life of bacilli outside body very short, hence no epizootic of rats occurs, and epidemic may be readily extinguished.

DISTRIBUTION.—Mainly a disease of tropics, but few countries have entirely escaped since present cycle commenced in 1894. In England, several small outbreaks in Suffolk. Rats in seaports in several countries are being systematically examined and plague-infected animals occasionally discovered. Frequency greatest in cool weather in the tropics, and in hot weather in temperate regions.

Bacteriology.—*B. pestis* isolated by Kitasato and by Yersin in 1894.

MORPHOLOGY.—Short fat bacillus with rounded ends and marked 'polar staining'. Non-motile and non-sporing. Stains with usual stains, but *Gram-negative*. Numerous involution forms occur in cultures, especially on Hankin's 'salt agar', agar containing NaCl. In tissues, mainly single: in liquid media may form chains.

CULTURAL CHARACTERISTICS.—Grows on agar and ordinary media. Most characteristic is Haffkine's 'stalactite growth' in butter-fat broth. Killed readily by heat and antiseptics. Old cultures lose virulence, but regain it on subculture.

METHODS OF ISOLATION.—(a) Bubonic plague: Puncture bubo with hypodermic needle, make and stain smears, and inoculate media. (b) Pneumonic plague: Smears from sputum; inoculate media. (c) Septicæmic type: Culture from blood; sometimes seen in blood films. Post mortem, bacilli present in every organ.

AGGLUTINATION REACTION.—Agglutinins appear about end of first week, but titre is not very high, and agglutinins often absent in severe and very mild forms. Reaction also complicated by frequent spontaneous agglutination of cultures. Results to be interpreted with care and only by experienced workers.

SUSCEPTIBILITY OF ANIMALS.—Guinea-pigs, mice, rats, rabbits, and most animals are susceptible. *Subcutaneous or cutaneous inoculation* results in: (1) Œdematous swelling at site of inoculation; (2) Nearest lymphatic glands enlarge, hæmorrhages present; (3) Septicæmia: bacilli present in blood. Death usually in two to four days. Bacilli in most tissues, especially spleen.

In monkeys: may be no local swelling at site of inoculation.

Morbid Anatomy.—

BUBONIC TYPE.—*Enlargement of lymphatic glands*, usually commencing in one group, most commonly axillary or inguinal, forming the 'primary bubo'. Other groups subsequently enlarge, forming 'secondary buboes', but to less extent. *Bubo:* Inflammation of glands, with extensive periglandular œdema; on section, hæmorrhages present;

Plague—Morbidity Anatomy, continued.

in early stages, masses of bacilli; later, advanced necrosis of cells, bacilli often few or absent.

Suppuration not uncommon, but does not occur until second week, and hence never in the rapidly fatal cases.

Hæmorrhages and focal necroses common in other organs, and cloudy swelling.

PNEUMONIC TYPE.—Patchy bronchopneumonia and areas of red hepatization. Bronchial glands enlarged.

SEPTICÆMIC TYPE.—General appearances of septicæmia with hæmorrhages.

SPLEEN.—Commonly enlarged.

SKIN.—Hæmorrhages may be either *petechial* or *diffuse and extensive*. Over a bubo, the skin may be discoloured by hyperæmia.

Duration of Infectivity.—Convalescents must be isolated for one month.

Quarantine Period.—Ten days.

Symptoms.—

INCUBATION PERIOD.—2 to 5 or possibly 10 days. Usually no symptoms. May be malaise. *B. pestis* has been found in blood.

CLINICAL TYPES.—(1) Bubonic; (2) Pneumonic; (3) Septicæmic. Bubonic is the commonest epidemic type.

1. **BUBONIC PLAGUE.**—*Sudden onset*: chill, headache, backache, restlessness, rapid pulse and respiration, high fever. Symptoms often fully developed in a few hours. Great prostration occurs rapidly, and often a typhoidal condition within one to two days. *Bubo*: usually in one to two days from onset. Femoral glands most common, next axillary. Cervical not uncommon in children. Swelling size of egg or larger. Very tender. Œdema may be extensive. Fever may fall slightly on appearance of bubo. Secondary buboes form later. Spleen usually palpable.

Symptoms usually *progress*: extreme prostration and cardiac weakness, tongue brown, sordes, vomiting common, and delirium. Death in two to seven days: usually three or four. Mortality at least 70 per cent.

In *favourable cases*, symptoms improve after bubo appears. In second week suppuration or resolution occurs. Prognosis improves after fifth day.

In certain epidemics, *petechiæ* and *hæmorrhages* common ('plague spots'). Hæmorrhages from mucous membranes in severe cases.

In children, convulsions at onset often so severe as to mask diagnosis.

Blood: polynuclear leucocytosis. Bacilli often numerous before death.

Temperature: High at onset, 103° to 104°. Subsequent course variable: not uncommonly falls after three to four days, and rises rapidly again in one to two days.

During convalescence, a tragic fatal cardiac failure is common. Prolonged tendency to boils.

2. **PNEUMONIC PLAGUE.**—*Sudden onset*: Rigors, pain, cough, fever, and extreme prostration. Rapid pulse and respiration. Cyanosis. Sputum watery and bloody. Patchy consolidation in both lungs. Spleen palpable. Invariably fatal in one to four days. Numerous bacilli in sputum.
3. **SEPTICÆMIC TYPE.**—All forms of plague become septicæmic, but this type specially includes cases without bubo or local signs. General symptoms severe and death invariable, frequently in one day. Hæmorrhages common. Does not occur as distinctive epidemic.

PESTIS MINOR.—Slight cases occur, especially towards end or beginning of epidemic and in inoculated persons. Bubo may form. Death from cardiac failure may occur.

Diagnosis.—During epidemic easy. When suspected, bacteriological proof simple. Early cases in epidemic easily overlooked. Suspect outbreaks of rapidly fatal pneumonia, especially with several cases in one household: also buboes from tropics and seaports. In tropics buboes occur from filariasis and also from unknown causes: also from syphilis and suppuration.

Prophylaxis.—*Vaccine treatment.* 'Haffkine's prophylactic' gives considerable immunity for a few months (three to six): severe reaction. All contacts should be inoculated. In small outbreaks, all contacts must be isolated, bedding and clothing burnt, and houses rendered airtight and disinfected with burning sulphur. A vaccine of living bacilli of an avirulent strain is under trial.

In large epidemics, a wide organization is necessary. The destruction of rats and examination of their bodies for bacilli, cleanliness of houses, and protection of uninvolved areas by quarantine are initial measures.

Treatment.—Careful nursing. To bubo, ice or fomentations: incise when fluctuating: injections into glands harmful. For mental symptoms, bromides. *Yersin's serum* in large doses possesses some value (100–250 c.c. intravenously, repeated frequently). During convalescence, avoid slightest cardiac strain.

CHAPTER XIV.

TETANUS.

(Lockjaw.)

An infective disease caused by the toxins of *B. tetani*, and characterized by spasms of the voluntary muscles, commencing usually in the jaw and neck, and extending to the rest of the body.

Etiology.—Occurs as a sequel to wounds and abrasions throughout the world wherever soil is cultivated and manured. Under equal conditions, more common and more severe in the tropics.

Tetanus—Etiology, continued.

Warfare in cultivated regions is always accompanied by tetanus. In the European War, it was prominent among all armies until greatly controlled by prophylactic injections.

Modes of Infection.—Contamination of wounds with infected soil containing bacilli or spores: septic and lacerated wounds and scratches more liable to infection than clean cuts, destruction of tissue forming anærobic medium for bacilli. Never by ingestion. Occasionally: from catgut (post-operative), freedom from spores difficult; also from injections of gelatin, frequently. *Idiopathic tetanus*: without a visible wound; infection through unbroken skin or forgotten scratch. *Tetanus neonatorum*: from sepsis to navel (among poor in the tropics).

Bacteriology.—*B. tetani* discovered by Nicolaier, 1885, and isolated by Kitasato, 1889, in pure culture anaerobically.

MORPHOLOGY.—Slender bacillus. Forms a terminal spore wider than bacillus, thus producing characteristic 'drum-stick' appearance. Stains with ordinary stains. Gram-positive. Weak methylene-blue, followed by carbol-fuchsin, stains bacillus blue and spore as a red ring. Slightly motile. Numerous flagella: need special stain. When spores present, bacilli may be recognized in pus. Some of the 'gas gangrene' bacilli are closely similar, but shorter and thicker, and spores rarely quite terminal.

CULTURAL CHARACTERISTICS.—*Strict anaerobe*. Isolation very difficult owing to simultaneous presence of other spore-bearing anaerobes. Methods mainly depend on resistance of spore to heat and subsequent growth anaerobically on numerous subcultures, trusting that one may be in pure culture.

Spores extremely resistant to heat or antiseptics; resist boiling for five minutes. Virulent for many years in dried cultures.

OCCURRENCE OF BACILLI.—Present in intestines of horses and herbivora and in their excreta. Consequently present in all heavily cultivated soil, especially a few inches below surface.

DISTRIBUTION OF BACILLI IN TISSUES.—Bacilli are present only at site of inoculation or in wound: practically never, if ever, present in organs or blood. Action is therefore due to toxin produced.

TETANUS TOXIN.—Injection of a filtered culture, i.e., pure tetanus toxin, produces all symptoms of tetanus. Toxin is highly potent. Ehrlich demonstrated presence of two types of poison: (1) Tetanospasmin, producing spasms; (2) Tetanolysin, hæmolytic to red cells.

MODE OF ACTION.

An *incubation period* is always present between injection and onset of symptoms, even with enormous doses. The period varies with dose and mode of injection, but, for similar methods, varies mainly with size of animals, e.g., guinea-pigs few hours, monkeys about four days, horses about five days.

Meyer and Ransom's Experiments.—(1) Tetanus follows injection into a motor (or mixed) nerve, but no symptoms result if nerve be divided proximal to site of injection previously or shortly afterwards (one hour). (2) No symptoms follow injection into a pure sensory nerve, e.g., infra-orbital. (3) If toxin be injected into a sensory nerve root, extreme hyperæsthesia with agonizing pain occurs in the corresponding area, but without spasms (tetanus dolorosus); hence the toxin can act on sensory nerve tissue.

Conclusions.—The toxin is absorbed by muscle end-plates, and travels by motor nerves to the central nervous system, where it combines with nerve tissues and symptoms commence. There is no transmission by sensory nerves. An incubation period is unavoidable during passage of toxin along nerves. After reaching the spinal cord, toxin ascends in it.

Toxin in the Blood.—A certain amount circulates in the blood and directly reaches the medulla and pons, producing generalized tetanus. Amount and effect of this varies in different mammals; apparently none in guinea-pigs.

SUSCEPTIBILITY OF ANIMALS.—Nearly all animals are susceptible, degree varying greatly. Hen needs enormous dose. Alligator is completely immune, toxin probably unable to combine with nerve tissue. Horse is very highly susceptible. Monkeys, mice, guinea-pigs also highly, but less than horse. In small animals, spasms commence in muscles nearest site of inoculation. In frogs, no symptoms occur after inoculation until warmed in an incubator to 37° C.

Mice: For testing discharges from wounds, introduce portion of pus into root of tail.

ANTITETANIC SERUM.—

PREPARATION AND IMMUNIZATION OF ANIMALS.—Animals can be immunized by injections of toxin, preferably by a toxin weakened by heat or keeping, by treatment with iodine, or by simultaneous injection of iodine trichloride. The serum of the animal has antitetanic properties, injections protecting against a subsequent lethal injection of toxin, or, in certain circumstances, against a previous injection, depending on mode of injection of serum and interval elapsing (*see also below*). Is antitoxic only; bacilli not affected.

STANDARDIZATION OF SERUM.—Standardized as 'international units' or American units (double international): latter corresponding to Ehrlich's unit for diphtheria serum, viz., one unit of serum protects against 100 'minimal lethal doses' (M.L.D.) of toxin, tested by mixing toxin and serum, injecting subcutaneously into standard guinea-pigs (250 grm.), and animal being still alive after four days. 'Concentrated' serum now produced; contains 1000 units in 1 c.c. Potency is maintained for long periods.

ACTION OF SERUM.—Meyer and Ransom's experiments: (1) Antitoxin injected into a nerve prevents the passage of a distal injection of toxin into the nerve; (2) Antitoxin injected

Tetanus—Antitetanic Serum, *continued*.

intravenously has no effect on a nerve injection of toxin ;
(3) An immunized animal can be killed by a nerve injection of toxin.

Conclusion : Antitoxin injected into the circulation only neutralizes circulating toxin.

FOR CURATIVE PURPOSES.—*In clinical tetanus*, serum is disappointing. Mainly due to absence of symptoms until toxin has reached central nervous system—no local lesion occurring—and to inefficiency of serum when this has taken place. Intrathecal method has no proved advantage, and disturbs patient.

TYPES OF TETANUS BACILLI.—Several types of bacilli have been separated by serological tests. It is considered that an antiserum is only effective against its own strain, and hence that antisera for clinical use should be 'polyvalent' against all types.

SHERRINGTON'S EXPERIMENTS ON MONKEYS.—A series of monkeys was inoculated with similar doses of toxin, and two to three days later, after commencement of symptoms, injected with antiserum. *Recoveries* by various methods : (1) Subcutaneous, 8 per cent ; (2) Intramuscular, 12 per cent ; (3) Intravenous, 28 per cent ; (4) Intrathecal, 56 per cent.

NOTES ON THE METHODS.—(1) *Subcutaneous and intramuscular*. Absorption of serum slow : maximum concentration in blood not until forty-eight hours later. Advantage : simplicity, possibility of injection near wound. (2) *Intravenous*. Absorption rapid, also elimination rapid. Large doses possible. Anaphylaxis may be severe. (3) *Intrathecal*. Theoretically, rapidly immunizes the tissues of the central nervous system.

Symptomatology.—

INCUBATION PERIOD.—Very variable. *Commonest eight to twelve days*. Very rare under five days : never under forty-eight hours. Upper limit doubtful ; definite cases of 100 to 200 days.

PREMONITORY SYMPTOMS (rarely observed except after prophylactic injections of serum).—Rigidity, twitching, irritability, spasms and pains in muscles near wound, especially flexors.

SYMPTOMS.—Characterized by the development of tonic spasm of muscles, with frequent paroxysms.

INITIAL SYMPTOMS.—May be slight sore throat, difficulty in swallowing, and stiffness of neck.

ONSET OF DEFINITE SPASM.—(1) *Masseters* and muscles of mastication. Often noted first on waking. (2) *Muscles of back of neck*. Spasm extends in order to (3) *Abdominal muscles*, especially recti ; (4) *Back* ; (5) *Limbs*.

Concomitant symptoms commonly are : (a) Profuse sweating ; (b) Rise of temperature ; (c) Rigidity of abdomen.

CONDITION DEVELOPED.—Tonic spasm and rigidity of muscles produce characteristic phenomena: (i) *Trismus*: severe spasm of muscles of mastication, teeth clenched, difficulty in feeding increased by spasm of pharyngeal muscles. Unable to open mouth or speak. (ii) *Risus sardonicus*: lips stretched over closed teeth in ghastly smile. (iii) Eyes partly closed: forehead wrinkled. (iv) Head retracted to varying degree. Back may also be bent (opisthotonos). (v) Lower extremities usually extended, very stiff: knees sometimes flexed. (vi) Elbows may be flexed. *Hands usually escape*. (vii) Abdomen very rigid.

Paroxysmal exacerbations of spasms, usually with agonizing pain, occur as result of stimuli, e.g., movements, sudden noises, or apparently spontaneously.

Pulse usually rapid, 100 to 120.

PROGRESS IN FAVOURABLE CASES.—Paroxysms diminish in severity and frequency: tonic spasm slowly passes away.

PROGRESS IN UNFAVOURABLE CASES.—*Paroxysms and rigidity increase in severity*. Pulse often very rapid. *Temperature* often high but irregular: occasionally low. *Urine* may contain acetone bodies, albumin, and casts.

Death may occur from (1) *Exhaustion*: in these the spasm may have continued several days without alteration: starvation a probable factor. (2) *Asphyxia*: spasm of respiratory muscles and glottis. (3) *Cardiac failure*: pulse very rapid.

Mental condition may remain clear: usually (and properly) obscured by sedatives.

Duration: death usually within seven days: uncommon after ten days.

SEQUELÆ.—Affected muscles may remain stiff for long periods, especially jaw muscles. *Recurrences* are on record, following shortly after apparent recovery. No other complications.

Prognosis.—Varies with:—

1. **LENGTH OF INCUBATION PERIOD.**—Improving in general as period lengthens; but specially marked in contrasting durations over and under eleven days. Approximate mortality: ten days and under, 60 to 70 per cent; eleven days and over, 40 to 50 per cent.
2. **RAPIDITY OF SPREAD** of stiffness and spasms, and also frequency and severity of spasms.
3. **SEVERITY OF WOUND.** (Site of wound of little influence.)
4. **HYPERPYREXIA, AND VERY RAPID OR IRREGULAR PULSE**, are serious signs.

Mortality of all cases, 45 to 70 per cent.

Diagnosis.—Onset in jaw and posterior neck muscles: note also sweating, early abdominal rigidity, and rise of temperature (rarely absent).

TRISMUS.—Reflex from teeth, Vincent's angina, tonsillitis, etc., or osteo-arthritis of jaw. No rigidity of neck muscles, or very slight. Difficulty rare.

Tetanus—Diagnosis, *continued*.

STRYCHNINE POISONING.—(1) Jaw and neck not specially affected ; (2) Complete relaxation between spasms ; (3) Temperature normal.

TETANY.—(1) Predisposing causes ; (2) Extremities mainly affected, with characteristic posture.

HYDROPHOBIA.—Psychical disturbances prominent. Spasms specially affect larynx.

HYSTERIA.—Nervous wounded men with knowledge of symptoms occasionally develop trismus : other symptoms absent.

BACTERIOLOGICAL METHODS.—Inoculation of mice alone reliable. Never delay treatment to await result.

Localized Tetanus.—Occurrence practically confined to European War (except cephalic type). Comparative frequency due to result of prophylactic injections of serum, probably preventing generalized tetanus but not completely neutralizing toxin.

INCUBATION PERIOD usually very long, many weeks.

ONSET with stiffness near wound : slight spasms follow : finally may be extreme chronic rigidity. In rare cases becomes generalized, and all intermediate forms occur.

PROGNOSIS.—Death very rare when spasm remains localized.

TREATMENT.—For first day or two full treatment of tetanus, but rapidly relaxed, especially serum, when condition remains localized.

CEPHALIC TETANUS.—Occurs only in wounds of head and neck. Spasm of masseters, muscles of face, and usually of pharynx, with facial paralysis. The facial paralysis is unilateral : rarely bilateral, and rarely absent. Almost invariably fatal.

Always rare, but great rarity during the War was noticeable.

Treatment.—Immediately on diagnosis (adapted from Cole).

REST AND QUIET.—Isolate in darkened room. Shoulders raised to aid respiration and relax abdominal muscles. Head supported. All disturbance and examination to be reduced to minimum.

FOOD.—Nutrition of great importance. Difficult owing to spasm of jaw. Nasal tube or tube through teeth if necessary. Fluids, milk and glucose. Rectal feeding only if unavoidable.

ANTITETANIC SERUM.—Intravenous injection of 200,000 units immediately (for precautions, *see* DIPHTHERIA).

WOUND.—Cleanse carefully one hour after serum injection.

SEDATIVES.—(1) *Chloral hydrate* gr. xv to xx : every 4 to 6 hours by mouth : or double dose by rectum if unavoidable. (2) *Avertin* : if spasms : one basal anæsthetic dose daily, or more frequently, if indicated. Give oxygen by nose and injection of atropine, if respiratory difficulty.

CURARE ; CURARINE HYDROCHLORIDE.—Under trial to relieve spasms. Avertin appears preferable.

Prophylactic Treatment.—

ANTISERUM.—Inject 500 to 1500 units intramuscularly for all punctured or severely lacerated wounds, especially if contaminated with soil or clothing. Incidence of tetanus greatly diminished and also severity if developing.

ACTIVE IMMUNIZATION.—Under trial with tetanus toxoid; not indicated in civilian life.

CHAPTER XV.

GLANDERS.

An acute or chronic infectious disease due to *B. mallei*, and primarily affecting horses and asses. Characterized in man by inflammatory and suppurative lesions arising especially in nasal mucous membrane and subcutaneous tissues, and occurring in an acute and a chronic form.

Bacteriology.—Bacillus discovered by Loeffler and Schutz in 1882. Isolated from man by Weichselbaum in 1885.

MORPHOLOGY.—A non-motile, non-sporing bacillus, in shape resembling tubercle bacillus, but thicker: is often beaded. *Stains* with ordinary stains: *Gram-negative*. *In tissues*, mainly extra-cellular: numerous in acute and scanty in chronic forms.

CULTURAL CHARACTERISTICS.—Grows readily on ordinary media: best on blood serum or potato at 37° C. Growth visible in two days. On potato, a yellowish growth, which by eighth day becomes a characteristic chocolate colour. Easily killed, except by drying.

GLANDERS IN ANIMALS.—Horses, asses, and mules especially affected. Cattle immune. Occurs in two forms: (a) Glanders, involving nasal mucous membrane; (b) Farcy, involving the lymphatics.

MODE OF INFECTION IN MAN.—Is a rare disease. Infection occurs by direct contagion from a diseased animal, the bacilli being discharged from the nostrils or from sores. Bacilli may enter the human being through nasal mucous membrane or abrasion of skin. Laboratory infection among experimenters occurs with exceptional readiness, and many deaths are on record. Infection from patients also common, and extreme care necessary.

Morbid Anatomy.—In acute forms lesions show ordinary suppurative changes. In chronic forms, an early glanders nodule resembles a tubercle, with greater acute inflammatory changes and less proliferation. Glanders is regarded as an infective granuloma.

Symptoms.—Glanders in man, infection being through the nasal mucous membrane, occurs in two forms—acute and chronic.

Glanders—Symptoms, *continued*.

1. ACUTE GLANDERS.—*Incubation period*: usually four to eight days. *Onset*: sudden or insidious with general malaise and pains in muscles and joints. Constitutional symptoms and evidences of general infection in 2 or 3 days:—

NASAL MUCOSA.—Nodules form, ulcerate, and discharge, with subsequent necrosis and foul discharge; nose becomes extremely swollen and red. Process extends to palate, mouth, larynx, pharynx, and bronchi.

ERUPTION OF PAPULES.—Especially on face and joints, rapidly becoming pustular, as in small-pox.

ABSCESSSES form: subcutaneous, muscular, and in joints.

BRONCHITIS.—Common, and frequently pneumonia.

EXTREME COLLAPSE and ACUTE SEPTICÆMIA follow. Liver and spleen often enlarged. Typhoid state may occur.

DEATH in from one to three weeks. Mortality 95 per cent. Albuminuria usually present. Secondary infections common, but lymphatic glands and testes not specially affected in man.

2. CHRONIC GLANDERS.—*Incubation period* 10 days or upwards. At *onset* may be rash, papular, pustular, or erysipelatous.

FORMATION OF ABSCESSSES is characteristic symptom, subcutaneous and intramuscular, especially near joints. Abscess ruptures: irregular ulcer results: discharge often very offensive. Abscesses often heal, and with great frequency break down again, or fresh abscesses form. Condition *often extremely chronic*: may be latent for months or years and then relapse and fresh abscesses form. *Recovery* in 50 per cent of cases, but at any stage, even after apparent cure, condition may develop symptoms of acute form and be fatal. In chronic condition nose and lungs usually escape, but there may be purulent nasal discharge.

FARCY.—Also occurs rarely in man, from infection through skin.

A spreading lymphangitis, with subcutaneous nodules—'farcy buds'—which form abscesses. May be acute or chronic.

Diagnosis.—

OCCUPATION.—Often suggestive.

CLINICAL DIAGNOSIS.—Extremely difficult. At onset, usually mistaken for acute rheumatism or influenza.

BACILLI.—These may be present in discharges, and recognized in films and cultures. Occasionally isolated from blood cultures.

INOCULATION INTO ANIMALS.—Intraperitoneal injection in guinea-pigs results in *suppuration of testes* in 2 to 3 days. Inoculation may be made from cultures or direct from discharge, but in latter case secondary pyogenic organisms may cause acute peritonitis rapidly.

INJECTION OF MALLEIN.—Is of great value *diagnostically* for animals but untried in man. Mode of preparation and technique resembles tuberculin. Precipitin, agglutination, and complement-fixation tests are also of value in animals.

Treatment.—

PROPHYLAXIS.—Glandered animals must be destroyed, and premises thoroughly disinfected. Attendants on patients must be warned of the danger of infection. Soiled linen, etc., should, if possible, be destroyed: otherwise, carefully boiled.

ACUTE CASES.—Treatment is symptomatic only.

CHRONIC CASES.—All abscesses should be opened as they occur.

CHAPTER XVI.

ANTHRAX.

(*Malignant Pustule. Wool-sorters' Disease. Splenic Fever in animals.*)

An acute infectious disease, caused by *B. anthracis*, occurring in man in a cutaneous form as malignant pustule; in a pulmonary form as wool-sorters' disease; and very rarely in an intestinal form.

Etiology.—Primarily a disease of animals, especially sheep and cattle, causing a septicæmia, with enlarged spleen and pulmonary congestion. Occurrence is world-wide, most frequent in Russia and France. Organism was discovered by Pollender in 1849, and investigated chiefly by Davaine, Koch, and Pasteur.

Bacteriology.—

MORPHOLOGY.—A large rod-shaped bacillus with clear-cut ends, length 6μ and upwards. Non-motile. Forms spores readily. Bacilli in cultures often joined end to end in a chain. Stains with ordinary stains, and is Gram-positive. Often a capsule.

SPORES AND SPORE FORMATION.—Never present in living tissues. Probably due to absence of free oxygen. Form readily in media and are always present in cultures. Especially frequent when organism is under slightly adverse conditions, e.g., lying on soil or in dead animals. Spores are seen in body of bacillus or lying free. Stain with weak carbol-fuchsin, while body of bacillus may be stained by methylene-blue.

Extremely resistant. When dry, alive after a year. Withstand boiling for 5 minutes. Very resistant to dry heat: also to gastric juice.

CULTURAL CHARACTERISTICS.—Grows readily on all ordinary media. Most characteristic are: On agar plates at 37° , in 12 hours, colonies visible with wavy outline like locks of hair. In broth forms long spiral threads. In deep gelatin stab, radiating spikelets and slow liquefaction, commencing at surface. Bacillus not very resistant apart from spores.

Filtered cultures non-toxic.

Anthrax in Animals.—Condition varies in severity, but is a septicæmia characterized by bloody mucous discharge from nose and mouth, the sanious discharges containing numerous bacilli. Death in twelve to forty-eight hours.

Cases vary in severity. Eschar may slough out, and recovery occur without treatment.

MORTALITY.—Varies with position of pustule. Most fatal on face, 25 per cent. On lower limb, 5 per cent. Post mortem the spleen is slightly enlarged and few bacilli present in organs. Mortality low with early treatment.

ANTHRAX ŒDEMA.—No pustule occurs. Infection possibly from hair follicle. Œdema commonly commences on eyelid and spreads rapidly. Rarely diagnosed, always fatal. Rare.

2. PULMONARY ANTHRAX OR WOOL-SORTERS' DISEASE.

—Infection occurs through the lungs. Onset rapid. Rigor, rapid respiration, pain in chest, rapid and feeble pulse. Cough and bronchitis usual. *Temperature* high. Œdema of chest wall develops, of gelatinous consistency. Much frothy mucus. Extreme collapse and death in one to three days. Mind usually remains clear.

PROGNOSIS.—Improves with longer duration. In some cases marked cerebral symptoms—convulsions, delirium, etc., due to bacilli in capillaries of brain. Diarrhœa occasionally severe. Recovery extremely rare.

MORBID ANATOMY.—Main lesion in trachea and large bronchi, with œdema and hæmorrhages. Lungs œdematous. Pleural and pericardial effusions. Great enlargement of thoracic glands. Apart from thorax, changes in the organs slight. Bacilli are numerous in the affected sites, but scanty or absent in the spleen and other organs.

3. INTESTINAL FORM.—A few outbreaks have occurred abroad, probably from diseased flesh. Resembles acute food poisoning. Chill, vomiting and diarrhœa, convulsions, enlarged spleen.

Diagnosis.—

MALIGNANT PUSTULE.—Diagnostic features are : (1) Occupation. (2) Appearance of pustule. Rapid onset, eschar, œdema, no pus, no pain. (3) Severity of general symptoms compared with local lesion. (4) *Bacteriology*. Bacilli are present in edge of eschar, and in cultures. Inoculation of cultures or material from pustule into guinea-pig causes malignant gelatinous œdema at site of inoculation, with hæmorrhages into organs, and bacilli present in large numbers, especially in capillaries.

DIAGNOSIS from *chancere* by rapid onset; from *cellulitis and erysipelas* by absence of pain; from *boils* by absence of pus; from *malignant œdema* (no gaseous crepitations); from *glanders* (no nasal discharge and no red vesicles).

PULMONARY ANTHRAX.—In early stages usually impossible.

Treatment.—

Inject Sclavo's serum, 100 c.c. intravenously. Repeat every 8 hours for 24 or 48 hours as necessary. The local lesion to be kept clean, but no surgical treatment, as septicæmia may follow. In absence of serum, injection of neosalvarsan, (neoarsphenamine).

CHAPTER XVII.

LEPROSY.

An infective disease of marked chronicity caused by *B. lepræ*, and characterized by lesions in the skin and mucous membranes or in the nerves, and in advanced cases frequently in both.

History and Geographical Distribution.—Is referred to in most ancient literature of the East, though probably other diseases were included. Is most prevalent in the tropics, but distribution is not limited geographically. Occurs in Norway and Iceland. Most frequent in India and China. In South Africa has recently increased. Formerly spread over the entire Old World, but commenced to decline in the 15th century. In Great Britain now only imported cases. Did not occur in America in days before Columbus.

Bacteriology.—The *B. lepræ* was discovered by Hansen in 1871. Slender, non-motile bacillus, resembling tubercle bacillus in appearance and staining reactions. Is Gram-positive and acid-fast (in 12 per cent acid). Stains with ordinary stains more readily than tubercle bacillus. Bacillus has never been cultivated satisfactorily. Possibly it is really a non-acid-fast streptothrix. Animals cannot be infected.

Morbid Anatomy.—The lesion is a granuloma. The *leprous nodule*, in any site, consists of granulomatous tissue with endothelioid cells of various sizes. Enormous masses of bacilli are present, mainly within cells. The so-called *lepra cells* contain numerous bacilli often arranged parallel. Some of these cells are probably lymphatics with thrombi of bacilli. Giant cells may be present. Caseation does not occur, unless tuberculosis is also present.

Terminally, tissues affected are skin, mucous membranes, and nerves, also liver, spleen, and testes.

Mode of Infection.—*B. lepræ* does not fulfil Koch's postulates, but is accepted as cause of leprosy. It has never been found outside the human body, and therefore infection, apparently, must be conveyed from a leper. The slow progress of the disease and immunity of animals have rendered investigation of modes of infection difficult, and nothing definite is yet known. Possible methods are :—

1. **INOCULATION.**—There is no evidence that biting or other insects can convey infection. Results of direct inoculation experiments in man are doubtful.
2. **HEREDITY.**—Has very slight, if any, influence. No new-born infant is leprous, and cases rare under 5 years. Several members of a family may be attacked, but are usually exposed to possibility of a common infection. Hansen found that of the

descendants of 160 Norwegian lepers who emigrated to America none was leprous.

3. **BY CONTAGION.**—The nasal mucosa is early infected, and numerous *B. lepræ* are present in the discharge. Infection may thus result by inhalation, though the lungs are rarely affected. The bacilli are also present in discharge from sores. This is most probable mode of infection. Attendants extremely rarely infected.

Children living with leprous parents are affected in 50 per cent. Nodular more infective than nerve type.

Mode of Onset.—

AGE.—Commonest between 10 and 30 years.

INCUBATION PERIOD.—Probably usually 2 to 4 years. Often longer before lesions are obvious.

INITIAL SYMPTOMS.—Often long period of recurrence of indefinite symptoms: fever, malaise, sweating, vague pains and disturbances. Later, deposit of leprous tissue predominantly either in skin or nerves, thus determining the principal groups.

Varieties of Leprosy.—Two main groups:—

1. **NODULAR OR DERMAL LEPROSY.**—Also called *tubercular* or *tuberosa leprosy*. Characterized by pyrexial attacks, and granulomata of skin and mucous membranes.
2. **NERVE OR ANÆSTHETIC LEPROSY.**—Also called *maculo-anæsthetic* or *atrophic leprosy*. Characterized by macules and nerve changes.

'MIXED' FORMS are common. These may:—

- i. Commence as 'nodular' and develop symptoms of 'nerve' type. Very frequent.
- ii. Develop both symptoms together. Less frequent.
- iii. Commence as 'nerve' and develop symptoms of 'nodular'. Uncommon.

MILD FORMS.—In some persons, macules develop only at periods of debility: may never advance, or one or two nerves alone affected. 'Juvenile type' may occur, often disappearing at puberty, but may advance. Many infected persons probably never develop lesions.

Symptoms.—

NODULAR LEPROSY.—

PRODROMAL SYMPTOMS.—Occasional pyrexia and malaise.

FIRST STAGE.—Attacks of fever with swelling or erythema of face. Fever subsides and a patch of erythema remains. Several attacks yearly for one to two years.

SECOND STAGE.—Repeated attacks of fever and erythema. Patches swell and become infiltrated. Usually hyperæsthetic. The 'tubercles' commence in the patches, at first as papules. They multiply, grow, coalesce, and form the typical flat masses of leprotic tissue. Masses become anæsthetic.

SITES ATTACKED.—Usual order: face (especially lobes of ear), then forearm, limbs, thighs, buttocks. Mucous membranes, especially nasal, as early as face.

Leprosy—Symptoms of Nodular Leprosy, *continued*.

ATTACKS OF FEVER (leprotic fever).—Duration varies, often one to two weeks. Frequently 102° to 103° . Rarely no pyrexia.

FULLY DEVELOPED.—Marked changes are :—

Face.—Natural lines obliterated and replaced by creases between masses of growth. Hair on face drops out, but scalp not affected. General expression sombre and 'leonine'. Ears, especially lobes, much thickened.

Mucous membranes.—Nasal discharge. Nose flattened. Pharynx and larynx affected. Vocal cords fixed—voice hoarse, or only whisper. Tongue infiltrated or ulcerated. Lips cicatrized and stenosed.

Limbs.—Covered with nodules and masses to varying degrees.

Eyes.—Affected commonly. Conjunctivitis, keratitis, etc.

SUBSEQUENT PROGRESS.—Variable: (1) Quiescent for many years, or marked remissions. (2) Exacerbations; more common. Pyrexial attacks occur, with spread of growth. Ulceration of masses common, with discharge: cicatrix on healing: often chronic. (3) 'Mixed' form frequently develops, with symptoms of 'anæsthetic' leprosy.

NERVE LEPROSY.—

ONSET.—Insidious. Progress very slow.

PRODROMAL SYMPTOMS.—Indefinite: malaise and chills, vague pains, hyperæsthesia, or deafness.

FIRST STAGE.—*Maculæ* are first sign, one or several. Diameter 1 to 2 inches. Areas of (1) *erythema*, (2) increased pigmentation, or (3) decreased pigmentation. Not raised. Sensation normal. Sweat glands of area affected, and patches are dry even after pilocarpine. Erythema of brown tinge in white races and light in coloured races. Fresh *maculæ* appear, sometimes in relation to a peripheral nerve.

Site.—Back and buttocks most common; face uncommon.

Ulnar nerve may be palpable at elbow in earliest stages.

SECOND STAGE.—*Maculæ* spread. Centre often fades and periphery extends and coalesces with others. Large area affected. Face often discoloured, but never 'white as snow'.

Areas anæsthetic, losing touch, heat and cold, and pain, in order.

Nerve trunks thickened: ulnar, then median, posterior tibial, and peroneal. Hence: (1) Anæsthesia of extremities, extending; (2) Contractions, especially of 4th and 5th fingers.

THIRD STAGE.—*Eruption* inactive: may fade. *Nerve lesions* extend; in rare cases become quiescent.

FULLY DEVELOPED.—

Skin.—Dry and parchment-like. *Anæsthesia* extreme.

Contractions.—Ulnar nerve especially affected, whence 'claw hand'.

Trophic changes.—(1) Perforating ulcers, arising from bullæ or injuries resulting from anæsthesia. (2) Loss of fingers, toes, or more extensive parts from necrosis or interstitial absorption of bone, or from gangrene or suppuration.

Eyes.—Affections result from lesions of 5th and 7th nerves, but not frequent.

Occasionally 'nodular' leprosy also develops.

Diagnosis.—Advanced cases easy. Syringomyelia difficult early.

EARLY NODULAR LEPROSY.—Bacilli present (1) in nasal secretion, (2) in excised piece of skin. Clinical diagnosis from syphilis, tuberculides, erysipelatoid attacks from septic foci. Wasserman reaction is often positive in leprosy.

EARLY NERVE LEPROSY.—Diagnosis depends on maculæ, thickened nerves, and anæsthesia. Often no bacilli in nose or skin.

Prognosis.—Either form may become arrested, especially when patients from the tropics are kept in cool climates. In usual condition, disease progresses over 20, 30, or more years, with death from nephritis, tuberculosis, or progressive exhaustion, especially in nodular form.

Treatment.—

GENERAL TREATMENT.—Diet and cleanliness of greatest importance. Europeans must not return to the tropics.

LOCAL TREATMENT.—CO₂ snow and other local applications have been used.

DRUG TREATMENT.—All modern methods depend on chaulmoogra oil or its constituents. Several varieties of tree exist: oil from *Hydnocarpus wightiana* is preferable. Methods:—

1. **CHAULMOOGRA OIL.**—*Dosage*: commence with ℥v t.d.s. orally, and increase to ʒij, for long periods. Large doses necessary produce nausea.
2. **ALEPOL.**—Sodium salt of fatty acids of chaulmoogra oil. Injections hypodermic, intramuscular, or intravenous. Promising results.
3. **ETHYL ESTERS OF CHAULMOOGRA OIL** (Burroughs Wellcome & Co.'s *Moogrol*: combined with iodine).—*Dosage*: weekly intravenous injections, 2 to 5 c.c.
4. **E.C.C.O.**—Contains ethyl ester of *Hydnocarpus wightiana*, creosote, camphor, and olive oil. *Dosage*: weekly intramuscular injections, 4 c.c.

Many other methods on trial.

Good results are recorded with newer methods above: but care is necessary with statistics, as arrest in leprosy may occur spontaneously.

PROPHYLAXIS.—Segregation and isolation are unnecessary when sanitary conditions exist in the home.

CHAPTER XVIII.

SCARLET FEVER.

(Scarlatina.)

An acute infectious disease due to a hæmolytic streptococcus, characterized by inflammation of the fauces and a punctate erythematous rash followed by desquamation, and by a special tendency to nephritis and otitis media.

There is much uncertainty as to duration of infectivity.

Etiology.—

GEOGRAPHICAL DISTRIBUTION.—In all temperate climates.

Endemic and frequently epidemic. Uncommon in tropics.

SEASON.—Marked seasonal prevalence. Increases during summer to maximum in October, rapid fall in December, minimum in March. Slight fall in August due to closure of schools.

AGE.—Most frequent about five years of age. Over 80 per cent under ten years. Frequency diminishes in each subsequent decade.

VIRULENCE.—Varies considerably in different epidemics and years. Present mortality 1 to 3 per cent, highest about 5 years of age. *Susceptibility* not so universal as in measles.

One attack usually protects for life.

SUSCEPTIBILITY OF ANIMALS.—No occurrence in nature and no experimental transmission.

Morbid Anatomy.—Nothing characteristic apart from kidneys. Rash not visible post mortem unless hæmorrhagic. Fauces: acute inflammation. *Cervical lymphatic glands* may be enlarged. General changes of acute fever, but spleen not enlarged. Pulmonary complications frequent in fatal cases.

RENAL CHANGES.—*Nephritis* not uncommon; changes usually not characteristic, but occasionally a pure 'glomerular nephritis'.

Bacteriology and Specific Reactions.—

STREPTOCOCCUS SCARLATINÆ.—G. F. and G. D. Dick (1923) isolated strain of hæmolytic streptococcus from case of scarlet fever: numerous similar strains now isolated: no cultural peculiarities. Evidence of relationship to scarlet fever:—

1. Cultures reproduce disease in human beings.
2. Cultures agglutinate with scarlet fever serum and absorb agglutinins.
3. Toxin produced by culture gives positive Dick test in those who have not had scarlet fever, and a negative test in those who have. Is neutralized by scarlet fever serum. Other hæmolytic streptococci give positive tests in every-body.

4. Toxin injected in appropriate doses causes mild symptoms of scarlet fever, and converts positive Dick test into negative.
5. Antitoxic serum, produced against this toxin, gives positive Schultz-Charlton reaction. Good therapeutic results in treatment of the disease.

SCHULTZ-CHARLTON REACTION (Rash-extinction Test).—

ORIGINAL TECHNIQUE.—Inject 1 c.c. of serum of convalescent scarlet fever patient intracutaneously into site of rash in scarlet fever patient. Area of blanching of one to several inches forms in 6 hours: lasts as long as rash. Probably toxin-antitoxin reaction. No blanching occurs with other sera, or with serum of scarlet fever before eighth day.

FOR DIAGNOSIS.—Inject 0.2 to 1 c.c. of 1-10 dilution of scarlet fever antitoxin.

DICK (SKIN) TEST.—Performed with toxin: resembles Schick test. Primarily is test for susceptibility; also used for diagnosis.

TECHNIQUE.—Intracutaneous injection of toxin, viz., 0.1 c.c. of 1-1000 dilution in saline of toxic broth filtrate: control with heated toxin on opposite arm. Red area begins in 4 to 6 hours: maximum 24-36 hours: quickly fades: best seen after 24 hours. Reactions positive, negative, pseudo, or combined, as in Schick test. May be negative for some days after injection of antiserum.

VALUE AND INTERPRETATION OF TEST.—

1. Is negative in those who have had scarlet fever.
2. Positive test indicates susceptibility.
3. In suspected case, negative test before or positive test after third day is against scarlet fever.

SUSCEPTIBILITY.—Test is positive under age of 6 months in 50 per cent; between 1 and 2 years in 70 per cent; after 20 years in 20 per cent (Zingher).

SCARLET FEVER ANTITOXIN.—Should be used for treatment early in all except very mild cases: results good, but no effect on complications when developed. Prepared by immunization of horses. *Dosage*: 10 c.c. intramuscularly for any age; repeat half dose in 24 hours if no improvement; if very severe inject intravenously. Use 'concentrated' serum.

PRELIMINARY TEST FOR HYPERSENSITIVENESS.—See DIPHTHERIA.

IMMUNIZATION.—For checking epidemics. Only necessary for those giving positive Dick test.

1. **PASSIVE IMMUNITY.**—Inject antitoxin: 2.5 c.c. between ages 5 and 15 years. Duration of immunity about ten days.
2. **ACTIVE IMMUNITY.**—Inject scarlet fever 'toxin': 3 injections, with intervals of one week, subcutaneously. *Dosage*: (a) Under 12 years—100, 250, and 250 skin test doses; (b) Adults—four injections, 500 doses increasing to 10,000 or more. Evidence of immunization, but no knowledge of duration.

Scarlet Fever, *continued.*

Mode of Infection.—

CONVEYANCE OF INFECTION.—(i) *Direct contact* with infected persons: usual cause. (ii) *Infected articles*: may be conveyed by clothes, books, etc., for long distances and time. (iii) *Third persons*. (iv) *Milk-borne epidemics*: milk may be infected in transit by individual with scarlet fever. Some epidemics have been ascribed to a certain pustular eruption of cows' udders, e.g., in 1885 (Klein), and 1909 (Hamer and Jones); the evidence is not fully conclusive.

Aerial conveyance negligible: no cases occur near fever hospitals.

Water of no importance.

INFECTIVE MATERIAL FROM PATIENTS.—(a) *Secretion of throat, nose, and ear*. Undoubtedly main cause of infection. Infectivity probably persists as long as nasal secretion is abnormal. Infectivity highest in prodromal and eruptive periods: then falls rapidly: few cases infectious after 4th week. (b) *From skin*. Generally considered infectious during rash. Infectivity from scales during desquamation is doubtful. No proof exists that scales are infectious at any time, but possibility is not disproved during rash. After fourth week, evidence exists that scales are not infectious.

Infectivity of urine is unknown.

'RETURN CASES'.—In 3 per cent of cases discharged, subsequent infection of the household occurs, usually within two weeks of discharge. Undoubtedly not connected with peeling, but cause not fully known. Often original case has nasal discharge or otorrhœa or faucial inflammation after leaving hospital. It is possible: (1) 'Carriers' exist for a short period, probably connected with nasal or other discharges. Simple coryza may cause these discharges to become actively infective. (2) Re-infection occurs from patients in earlier stages: no evidence for this, and contrary to rarity of relapse.

One attack protects.

Duration of Infectivity.—General principles:—

1. *Isolation should be complete for six weeks* from development of rash.
2. It is unnecessary to wait until desquamation is complete.
3. No case should be regarded as free from infection in which *nasal or aural discharge* is present. If these persist, isolation must be complete for minimum of twelve weeks, and preferably up to twenty weeks.

Quarantine Period for Contacts.—Ten days.

Incubation Period.—Generally two to four days, most commonly three days. Limits half to six days.

Clinical Varieties.—

Four types: (1) Simple ordinary form, scarlatina benigna; (2) Malignant or toxic; (3) Hæmorrhagic; (4) Septic or anginose. Intermediate types occur. All severe forms are rare.

SYMPTOMS.

1. **Simple Scarlet Fever** (*scarlatina benigna*).—Three stages: (1) Invasion; (2) Eruption; (3) Desquamation.

1. STAGE OF INVASION.—

ONSET.—Sudden. Chilly sensations; definite rigors infrequent. Convulsions not uncommon in children: also epistaxis.

INITIAL SYMPTOMS.—(a) *Sore throat*, with some tenderness on swallowing or in submaxillary region. (b) *Vomiting*, early and constant. Sore throat is commoner in adults, and vomiting in children. (c) *Temperature* rises rapidly, often 103° to 104° when first taken. (d) *Pulse* very rapid, especially in children. *Skin* dry and very pungent. *Face* flushed. *Tongue* furred. General malaise and constipation.

No definite diagnosis until rash appears. If early signs mild, attack mild; if severe, attack may still be mild.

2. STAGE OF ERUPTION.—*Rash* commences twenty-four to thirty-six hours after onset, i.e., on second or third day; occasionally more rapid: rarely delayed for three to four days. General *exacerbation of symptoms*: throat more swollen and painful, tongue more furred, temperature higher, and pulse more rapid. Symptoms increase for two to three days; then, simultaneously, rash fades, defervescence occurs, and symptoms abate.

Convalescence usually on sixth to eighth day.

3. STAGE OF DESQUAMATION.—As rash subsides, skin is stained and rough. Desquamation or peeling commences on the neck, follows order of rash, and *occurs last on palms and soles*. May commence before rash has faded on limbs. Extent proportional to rash. On the face it begins at numerous foci and separates as powder; on abdomen as scales; on soles of feet as large flakes. Most marked in second week, usually complete in four weeks except soles. May be many weeks. Usually slight in infants. Slight secondary desquamation is common. Nails subsequently have transverse ridges not infrequently. Desquamation occasionally absent in infants.

Special Features.—

RASH.—Onset on second or third day.

DISTRIBUTION.—*Commences* on neck, behind ears, and upper part of chest; spreads over body, usually in a few hours; may take two or three days.

Chest and neck, flexor surface of elbows and knees, and inner aspect of thighs most affected.

Face, scalp, palms, and soles very rarely affected.

CHARACTER.—A vivid, scarlet, punctate erythema, composed of two factors: (a) scattered red spots, on (b) basis of general erythema. Disappears on pressure, unless petechial.

Skin smooth at first, then rough. Swelling and inflammatory oedema not infrequent, especially on hands.

Miliary sudamina or even vesicles may be present.

Scarlet Fever—Symptoms—Rash, continued.

Petechiæ not uncommon, especially in folds and creases of skin and on neck. Itching varies: rarely excessive.

Rash on extremities sometimes blotchy and macular.

DURATION.—Usually two to three days: darkens in colour and fades roughly in order of appearance, last from sites where thickest. Generally absent by seventh to eighth day.

Petechiæ may persist longer. When rash subsides, may be transverse red lines at bend of elbow, often persisting long.

FACIAL ASPECT.—*Cheeks flushed*, while mouth and nose are pale, so-called 'circumoral pallor'—Filatow's sign—often very suggestive. Bluish, peach-blossom tinge of cheeks, as if rouged.

FEVER.—High at onset (103° to 104°), maximum on third or fourth day: slight morning recession. Declines with fading of rash. Normal in one week.

PULSE.—Rapid, out of proportion to temperature: usually 120 to 150.

TONGUE.—In stage of invasion is furred in centre, with red papillæ projecting, and red at edges, the 'strawberry tongue'. Fur clears on third or fourth day, leaving surface red and raw, 'raspberry tongue'.

FAUCES.—The changes may be: (a) Slight redness and swelling; (b) Follicular tonsillitis; (c) Membranous angina—great tenderness and induration in neck and swelling of glands.

CERVICAL LYMPHATIC GLANDS.—Palpable.

SKIN.—Hot and extremely pungent.

These symptoms, with the early occurrence of vomiting, and the subsequent desquamation, are the characteristics of scarlet fever.

RHINORRHOEA.—Mucous discharge common.

BLOOD.—Polymorphonuclear leucocytosis present.

URINE.—Febrile changes with early albuminuria.

GASTRIC DISTURBANCE.—Uncommon after initial vomiting.

SPLEEN.—Rarely palpable.

WASSERMANN REACTION.—May be positive for a short period about the third day. (Doubtful.)

Progress of Symptoms.—

First Day.—Sore throat, vomiting, high temperature.

Second Day.—Rash, strawberry tongue, rapid pulse.

Fourth Day.—Rasperry tongue.

Fifth Day.—Rash, temperature, and symptoms commence to decline.

Sixth to Eighth Day.—Temperature normal, symptoms subside, desquamation commences.

2. Malignant or Toxic Scarlet Fever.—Characterized by slightness of throat lesions with severe constitutional symptoms. Onset severe—serious vomiting, high temperature, and delirium. Fauces little changed. *Rash dusky*, or may be absent.

Subsequently: dyspnoea, rapid pulse, hyperpyrexia, coma, and cardiac failure. Is a toxæmia.

Adults occasionally recover; children never. *Death* in one to two days, rarely longer.

- 3. Hæmorrhagic Scarlet Fever.**—Very rare. Hæmorrhages into skin and from mucous membranes, including epistaxis and hæmaturia. Invariably fatal, usually second or third day.
- 4. Septic or Anginose Scarlet Fever.**—Characterized by ulceration and necrosis, commencing in fauces and spreading widely.
- CONSTITUTIONAL SYMPTOMS.**—Severe from onset, but septic condition prominent from third or fourth day.
- FAUCES.**—*Lesions severe*: tonsils and palate extremely swollen, extensive exudation or membrane formation. *Necrosis* commences at junction of uvula and tonsil. Sloughing may be extensive and fatal hæmorrhage may occur.
- NASAL DISCHARGE.**—Mucopurulent.
- CERVICAL GLANDS.**—Enlarged and matted together: cellulitis of neck may develop.
- RASH.**—Generally marked, often delayed to the fifth day, usually dusky, blotchy on extremities.
- PROGRESS.**—Improvement may commence after two weeks. In other cases, ulceration and necrosis extend irregularly. Palate may perforate. Stomatitis severe. Aspiration pneumonia may develop. Temperature high: 104° to 106° . Constitutional symptoms severe: rapid wasting, marked prostration, cardiac failure. *Death* in second or third week. If patient lives into fourth week, sloughing of glands of neck (commonly), otitis media, or boils may occur and be fatal. 'Secondary rashes' of septic origin not uncommon in third week.
- PROGNOSIS.**—Mortality is high, but many cases recover. Wasting and weakness are always extreme, and convalescence prolonged.
- Note.*—Syphilis may be imitated by perforation of the palate; also stomatitis on corners of mouth may result in radiating scars.

ATYPICAL VARIETIES.

Mild and Abortive Forms.—

MILD.—All symptoms very mild, brief, and easily overlooked.

SCARLATINA SINE ERUPTIONE.—Rash may be absent: sore throat and pyrexia only; but may transmit typical disease. Frequency unknown. Often at onset of epidemics.

Surgical Scarlet Fever.—Symptoms indistinguishable from scarlet fever, but always mild. Liability to follow burns and scalds definite: more rarely in operation and other wounds. Incubation period short. Infectivity slight, but exists.

Puerperal Scarlet Fever.—The relation between scarlet fever, puerperium, and puerperal septicæmia has been much discussed. If occurring late in pregnancy, abortion may result; if at time of labour, there is liability to septicæmia.

IMPORTANT COMPLICATIONS.

1. Renal (see also MORBID ANATOMY).—

INITIAL ALBUMINURIA.—Of febrile origin, not uncommon while temperature high, disappears when temperature falls: unconnected with subsequent nephritis. No subsequent symptoms.

Scarlet Fever—Renal Complications, *continued*.

NEPHRITIS.—Occurs in about 3 per cent of cases ; varies in different epidemics. *Onset* usually towards end of third week : may be later. No age exempt, but commoner in children. May occur even in mild cases, but especially in septic forms.

SYMPTOMS.—All grades of severity, from simple albuminuria, to acute diffuse glomerular nephritis with definite symptoms, and blood, casts, and much albumin in urine.

TERMINATION.—

- a. Recovery*, in great majority. If urine becomes free from albumin, kidney may be regarded as entirely recovered. Duration of attack usually about four weeks, but with relapses may be several months.
- b. Chronic nephritis*. Rare, but frequency uncertain.
- c. Uræmia*. Very rare. Nephritis always acute.

2. **Otitis Media.**—Especially in children : rare after age of 15. *Onset* any time after first week, rarely earlier. Is due to extension of inflammation from fauces. In septic forms and angina almost invariable, but also common in mild attacks. May be usual symptoms of earache, etc., but more frequently no pain until otorrhœa occurs. Often bilateral.

PROGRESS.—Usually good, *with efficient treatment*, discharge ceasing in two to four weeks, and in these cases hearing not greatly affected. Complete deafness from labyrinthitis rare. *Mastoid abscess* develops occasionally : mortality high owing to sequelæ of thrombosis of lateral sinus, pyæmia, cerebral abscess, and meningitis.

3. **Arthritis.**—(i) *Multiple arthritis* (rheumatism) : very frequent in adults, uncommon in children. Commences at end of first week. Small joints mainly affected. Changes in joints slight or absent. Usually, but not invariably, reacts to salicylates. Prognosis good. Chorea and cardiac affections rare. Probably unconnected with acute rheumatic fever. (ii) *Pyæmic suppuration* of joints : rare, but usually fatal.
4. **Adenitis.**—Practically constant. (i) In simple and mild types, submaxillary glands tender and swollen ; (ii) In anginose and septic types, extreme swelling of glands, with cellulitis or subsequent sloughing. An adenitis may occur in third week, especially with nephritis. Rarely a suppurative adenitis develops in the fourth week. *Retropharyngeal abscess* occasionally occurs during convalescence.
5. **Diphtheria.**—Occasionally occurs in convalescence, usually fourth week. Commonly no membrane present. Tonsillitis or nasal discharge commencing late should be examined bacteriologically.
6. **Cardiac Complications.**—(i) Sudden death during convalescence, usually no previous warning, very rare ; (ii) Endocarditis, rare ; (iii) Malignant endocarditis or purulent pericarditis in septic type.

7. **Rhinitis.**—Very frequent. Nasal discharge at first thin and irritant, later mucopurulent; often obstinate; undoubtedly infective.
8. **Bronchitis.**—Common in children; usually present in fatal cases.

Rare Complications.

Shorea, Acute Poliomyelitis and Various Paralyses, Stomatitis, Noma, Perforation of Palate, Purpura (prognosis bad).

Typhoid Form.—Temperature sometimes persists for several weeks, and a typhoid state develops and may be fatal. Initial throat symptoms often slight. Usually due to a septic focus. Cervical adenitis may be present. Occasionally no cause found.

Secondary Rashes.—Usually severe cases: generally second or third week. Many types occur, e.g.: (a) Scarlatiniform, especially on trunk and extremities. (b) Septic rash, mainly on extremities: irregular, blotchy, papular, or macular eruption.

Relapses.—True relapses occur in about 1 per cent.

Association with Other Diseases.—Not uncommon: with diphtheria in 2 per cent, chicken-pox 2 per cent, measles 1 to 2 per cent of cases.

DIAGNOSIS.

Often simple, especially in cases of moderate severity: in mild forms, often very difficult: in the rare very acute forms, diagnosis may depend on existence of an epidemic, or knowledge of exposure to infection or a previous attack. Diagnosis never certain previous to eruption. The Dick test and Schultz-Charlton reaction are of assistance. Cultures from fauces may show hæmolytic streptococci, but no conclusion can be drawn.

Differential Diagnosis.—*Difficulties in diagnosis* arise from: (1) Inflammations of the fauces: (a) follicular and catarrhal tonsillitis; (b) diphtheria. (2) Various eruptions: measles; rubella; small-pox, initial rashes; erythemata of various types.

ACUTE TONSILLITIS.—*Catarrhal tonsillitis* identical with throat of scarlet fever, and early diagnosis usually impossible; but tongue remains furred, rash absent or pure erythema, and no subsequent desquamation. *Follicular tonsillitis* is not so common in scarlet fever, but in diagnosis this is only of slight assistance.

DIPHTHERIA.—May coexist. Diagnosis often impossible except by bacteriological examination. Usually in diphtheria: (i) Temperature is lower and pulse less rapid; (ii) Aspect gray; (iii) Vomiting not so common; (iv) Albuminuria early; (v) Strawberry tongue uncommon.

In scarlet fever, membranous angina rarely spreads to larynx, but is more extensive on fauces, while glands are larger.

MEASLES.—See MEASLES, p. 264.

RUBELLA.—Diagnosis from mild scarlet fever often difficult. Note: (i) Short prodromal period; (ii) Constitutional symptoms slight—no vomiting, no 'strawberry tongue'; (iii) Sore throat

Scarlet Fever—Differential Diagnosis, *continued*.

slight; (iv) Occipital glands enlarged; (v) Rash occurs on face and often palate. Though frequently coalescent on trunk, rash is usually discrete on lower extremities.

SMALL-POX.—Prodromal rash often scarlatiniform in character, but usually localized distribution. Rash transient; initial rigor and symptoms; true eruption by fourth day; no sore throat.

ERYTHEMATA.—The rash in erythemata of various origins may resemble scarlet fever more or less closely. Desquamation may follow any erythema. The history and other symptoms usually indicate the diagnosis. The most important are:—

1. **DRUG RASHES.**—Especially belladonna, quinine, and salicylates. Iodide and bromide rashes are usually pustular.
2. **ANTITOXIN RASHES.**
3. **SEPTIC RASHES.**
4. **ENEMA RASH.**—Generally within few hours of enema, and usually confined to trunk.
5. **FLANNEL RASHES.**
6. **ACUTE EXFOLIATIVE DERMATITIS.**—Rare. Rash and even symptoms may resemble scarlet fever at onset. Rash more persistent, may be several weeks. Tendency to relapses and recurrences. Eosinophilia may be present.
7. **RECURRENT SCARLATINIFORM ERYTHEMA.**—Constitutional symptoms slight. Desquamation commences early. Rash recurs over many weeks. Not infectious.

Diagnosis in Post-febrile Stage.—Rash may linger on outer surface of legs. Peeling latest on palms and soles. Transverse lines at elbows, and cervical glands, may assist.

PROGNOSIS.

AGE.—Highest mortality in infants under one year. Greatest number of deaths occur at about 5 years. Mortality subsequently very low, and diminishes with increasing age.

GENERAL MORTALITY.—Not exceeding 3 per cent: usually lower, but varies in different epidemics.

CLINICAL TYPES.—*Malignant and anginose* types have highest mortality: usually cardiac failure either in first few days or later stages. *Ordinary types*: deaths almost confined to complications.

COMPLICATIONS.—*Diphtheria*: considerable mortality. *Otitis media*: prognosis good except with sequelæ, when mortality is high. *Nephritis*: prognosis good when recognized and treated, especially in adults: when overlooked, or initial scarlet fever missed, mortality higher: chronic nephritis rarely develops: serious if previous nephritis existed.

SERIOUS SYMPTOMS.—*Bronchitis* in children. Severe vomiting. Hyperpyrexia, very rapid pulse, delirium. Excessive œdema or exudation on fauces. Rapid emaciation in later stages.

TREATMENT.

Antitoxin.—Inject early (*see* p. 121).

Prophylaxis (*see* MODE OF INFECTION, p. 122).—Patients must be isolated completely. Careful sterilization of hands by attendants. Contacts should be Dick-tested and throat swabs cultured for hæmolytic streptococci: positives should be isolated.

General Hygiene.—Isolation in bed. Carpets, etc., removed. Temperature constant, not over 60°. Air dry: free ventilation. Light clothing. Tepid sponge daily. Encourage drinks of simple lemonade. Morning saline aperient. During desquamation, rub with carbolyzed vaseline. Test urine daily for albumin, especially in second or third weeks. Sit up when temperature normal one week. Out of bed three weeks from onset. Out of doors a few days later, but avoid chills.

Diet.—In febrile stage, milk, beaten-up eggs, and custard. When temperature normal, add bread and butter, milk puddings, fruit. There is no evidence that diet affects the incidence of nephritis. With much faucial tenderness semi-solids easier than fluids, e.g., custards and jelly. Meat juice also useful temporarily.

Faucial Lesions.—Must always be treated locally. In mild cases swab or spray with antiseptics, e.g., listerine, hydrogen peroxide. In severe cases, especially septic type, syringe gently from douche-can with above solutions. After improvement, swab with carbolic, 1-60.

For ulceration of larynx, use bronchitis kettle with steam tent. Tracheotomy if marked dyspnoea: never intubation.

Local treatment as above 3-hourly to three times a day.

Cervical Adenitis.—Ice better than hot fomentations. Do not incise too early.

Nasal Passages.—In septic cases or with rhinorrhœa or adenoids, syringe nasal passages gently with warm water or salt water. Prevent nose-picking. Treatment probably protects the ear.

Otitis Media.—For earache, hot fomentations over the whole ear. Pour a few drops of warm laudanum into external meatus. If severe, leeches behind ear. Watch drum, puncture if bulging. For otorrhœa: treatment by usual methods.

Arthritis.—Wrap limbs in cotton-wool. Salicylates usually control pain. Practically never serious.

Hyperpyrexia and Delirium.—Especially occurs in septic type. Treat by hydrotherapy. Above 103° tepid sponge. If still rises, warm bath, commencing at 90°, cooling to 80°. If delirium present, cold packs preferable. Antipyretic drugs useless.

Malignant Form.—Give stimulants, especially brandy and champagne. Wet packing or baths.

Diphtheria, Nephritis.—Treatment on usual principles.

Convalescence.—Post-scarlatinal anæmia is frequent, especially with nephritis. In all cases give iron tonic.

CHAPTER XIX.

TULARÆMIA.

A specific infectious disease caused by *Bacterium tularensis*, and characterized by fever, glandular enlargement, and septicæmic symptoms.

Etiology.—Is primarily a disease of rodents, squirrels, rabbits, hares, etc., causing plague-like changes. Conveyed to man by bites of blood-sucking insects, and by handling (and possibly consuming) infected animals. Laboratory infections occur with exceptional ease.

Bacterium tularensis: minute Gram-negative cocco-bacillus: difficult to culture: serological affinities with *Brucella* group.

Geographical Distribution.—Reported in America, Japan, Russia, Norway, Sweden, and Austria. Probably widespread but unrecognized.

Symptoms.—

INCUBATION PERIOD.—Two to five days.

1. **ULCERO-GLANDULAR TYPE.**—From infected bites. Papule forms at site and necroses, leaving ulcer. Lymphatic glands in area enlarge and may suppurate. Onset of symptoms sudden: fever, scattered pains: duration 2–3 weeks. *Oculo-glandular type*: conjunctivitis, oedema of lids, enlarged glands in neck. Mortality low.
2. **TYPHOIDAL TYPE.**—Constitutional symptoms without local lesions: pyrexia, pains, lassitude. Pulmonary complications common: many fatal cases. Otherwise recovery in weeks or months: relapses common.

Diagnosis.—From enteric, rat-bite fever, plague. *Agglutination reaction*: positive in second week. Organism obtained by injecting ulcer juice into guinea-pigs. Blood-cultures negative.

Treatment.—Symptomatic.

CHAPTER XX.

TUBERCULOSIS.**I. GENERAL FEATURES, ETIOLOGY, AND HISTOLOGY.**

History.—Pulmonary tuberculosis was known to the Greeks. Considered as contagious by Hippocrates and Galen, and generally so believed until early in the nineteenth century.

SYLVIVS, 17th century, described the tuberculous nodule and its relationship with phthisis, and considered the nodule similar to scrofulous glands. **MORTON** in same period also described the nodule.

LAENNEC, 1819, traced changes from tubercles to caseation, ascribed all forms to tuberculosis, upholding the 'unity of tuberculosis', and discovered the physical signs, but unfortunately considered it non-contagious. View became widespread that condition depended on special diathesis.

VIRCHOW opposed the 'unity of tuberculous lesions', considered that scrofula and tuberculosis were independent, and believed that ordinary inflammatory lesions might end in tuberculous caseation.

VILLEMIN, 1868, experimentally reproduced tuberculosis in animals, thus proving contagious nature. These researches were widely discussed but their conclusiveness by no means recognized. At this period, the morbid anatomy and histology was carefully studied.

COHNHEIM AND SALOMONSEN, 1879, injected tuberculous matter into the anterior chamber of the eye of guinea-pigs and rabbits, tuberculous nodules resulting and, later, disease of lymphatic glands and finally acute tuberculosis. These experiments were widely accepted as proof of contagion. Search for the causal bacterium was now in progress.

KOCH, 1882, announced discovery of *B. tuberculosis*: and by isolation, cultivation, and inoculation into animals finally proved its contagiousness and the tuberculous nature of many lesions. The contagious theory, thus proved, temporarily obscured the importance of diathesis and of other factors.

EHRLICH, immediately on publication of the above, discovered the acid-fast method of staining which, with slight modification, is known as Ziehl-Neelsen's method.

KOCH, 1889, reported the preparation of *tuberculin*, for which curative powers were claimed. Koch did not consider that his investigations were complete, and published them prematurely under pressure.

KOCH, 1901, made the statement that human and bovine tuberculosis were independent, and that man could not be infected from animals. See BACTERIOLOGY.

Bacteriology.—

B. tuberculosis is the essential cause. Is a streptothrix (sometimes called *Mycobacterium tuberculosis*).

MORPHOLOGY.—*Thin rods*, straight or slightly bent: *beading often present*. Ends may be thickened. In tissues scattered or frequently in small clumps. Filaments and aberrant forms in old cultures.

GROWTH IN CULTURE.—Special media necessary. None on ordinary media. On Koch's inspissated blood serum appears about fourteenth day, forms dry scales. Subcultures grow on glycerin agar.

STAINING REACTIONS.—Affected by presence of a fatty capsule. With ordinary stains, very slow. Best stained by Ziehl-Neelsen's carbol-fuchsin method, being 'acid-fast' (and also 'alcohol-fast', thus differing from smegma bacillus). Gram-positive, but stains very slowly.

Tuberculosis—Bacteriology, *continued*.

RESISTANCE.—Marked. Virulent in dried sputum after two months. Killed by 100° C. in fluids and tissues, but virulent after an hour if dry. Not destroyed by gastric juice. Rapidly destroyed by sunlight; also by carbolic acid, 1-20.

OCCURRENCE OF THE BACILLUS IN THE BODY.—

IN ACUTE LESIONS.—Often numerous, especially with rapid caseation. Numerous in spleen in acute tuberculosis in children. Present, though less numerous, in urine, cerebrospinal fluid, and fæces, in tuberculosis of respective systems: in pus, when caseation rapid. In acute miliary tuberculosis, rarely numerous.

IN CHRONIC LESIONS.—Very scanty, e.g., in pleural effusions, caseous matter, lymphatic glands. Animal inoculation often necessary for proof of presence. Bacilli usually extracellular: occasionally a few in giant cells, leucocytes, and epithelioid cells. In cattle, in general more numerous and commonly in giant cells.

IN BLOOD.—Occasionally in miliary and advanced pulmonary tuberculosis.

OUTSIDE THE BODY.—Chiefly present in milk. Isolated from dusts of streets, etc., but often absent, even in sanatoria.

VARIETIES OF B. TUBERCULOSIS.—Four principal types: (1) Human; (2) Bovine; (3) Avian; (4) Piscine.

Avian.—Birds, including fowls, are immune to human type.

Avian type is not found in man.

Piscine.—Morphologically resembles human type, but no growth above 26° C.; non-pathogenic to mammals.

In pigs the type is nearly always bovine, rarely human or avian: lesions intestinal.

HUMAN AND BOVINE TYPES IN MAN.—In percentages:—

	Human	Bovine
Cervical glands	35	65
" " (under age of 5 years) ..	15	85
Bones and joints	65	35
Pulmonary	97	3
Primary abdominal	18	82
Lupus	50	50

ROYAL COMMISSION CONCLUSIONS, 1912.—Two main types of bacillus, human and bovine, differing in:—

- CULTURE.**—Human: growth abundant (eugonic), dry, scaly, and yellowish. Bovine: bacillus shorter and thicker; growth scanty (dysgonic), especially on glycerin media, moist, white, and smooth; vitality less.
- VIRULENCE.**—Bovine more virulent to animals. Inoculated into cattle, bovine causes fatal general tuberculosis; human, a local lesion only. To rabbits, bovine is fatal and human non-virulent. Both virulent to guinea-pigs.
- DISTRIBUTION.**—Cattle: always bovine bacillus. Man: both types.

4. **TRANSMUTATION.**—No proof that bovine changes to human type in the body.

CONCLUSIONS: (1) Infection in phthisis is of human origin, with rare exceptions; (2) Primary abdominal disease and cervical adenitis are predominantly bovine.

OTHER ACID-FAST BACILLI occur widely spread, e.g., in butter (Rabinowitch's bacillus), in milk, hay (Timothy-grass bacillus): may cause local lesions on injection. Also, in animals, John's bacillus (chronic bovine pseudotuberculous enteritis).
Smegma bacillus: acid-fast but not alcohol-fast.

Mortality.—Death-rate per million living in England and Wales: 1851-1860—all forms 3478, pulmonary tuberculosis 2772; 1931-1935—all forms 782, pulmonary tuberculosis 620. Death-rate commenced to fall before discovery of tubercle bacillus.

Distribution and Occurrence in Nature.—Widely distributed. Prevalent in man, cattle, and birds, especially fowls. Common in pigs. Occurs in fish. Rare in dogs, cats, sheep, goats, and horses. Not in rabbits or guinea-pigs, though both very susceptible to experimental inoculation. Common in confined monkeys.

Predisposing Causes.—The tubercle bacillus is almost universal. Post-mortems show some tuberculous lesion in 80 per cent: by von Pirquet's reaction Hamburger estimates that by age of twelve 90 per cent of people have been infected. Hence predisposing causes are of vast importance, influencing result of an infection with tubercle bacilli. Predisposing influences may be inherited or acquired.

HEREDITY.—Tuberculous diathesis long recognized. Two types often described: (1) *Hippocrates' habitus phthisicus*: delicate skin, blue sclerotics, thin flat chest, winged scapulæ; (2) Scrofulous type: coarse skin, broad face and features, short heavy bones and build. Karl Pearson by statistical studies has shown importance of heredity.

AGE.—Occurs at all ages. Under 10 years, tuberculous meningitis is cause of 70 per cent of deaths from tuberculosis. Pulmonary tuberculosis rare under 15 years, then incidence rises rapidly: maximum 18 to 45 years.

SEX.—Is not a factor.

RACE.—Very fatal to negroes. Jews, low mortality.

ENVIRONMENT.—Important. Bad ventilation, spitting, and ancillary factors, account for mortality in poor districts. General debility important.

OCCUPATIONAL.—Influences: (1) General, as in environment; (2) Special in certain occupations (see PNEUMONOCOCCIOSIS). Coal-miners usually free.

RELATION TO OTHER MORBID CONDITIONS.—

PREDISPOSING TO INFECTION or to spread of a latent focus:—

1. *Certain acute respiratory affections.* Not infrequent after influenza, measles, whooping-cough. Pneumonia does not predispose to tuberculosis: cases so terminating are tuberculous from onset: so also with pleurisy and bronchitis. Emphysema and asthma are not factors.

Tuberculosis—Predisposing Causes, continued.

2. *Congenital morbus cordis*. Frequent as a termination.
3. Diabetes, alcoholism, chronic nephritis, cirrhosis of liver: terminal phthisis frequent.

PREGNANCY.—It is generally accepted that a woman with phthisis can pass with comparative safety through one pregnancy, and may with difficulty through a second, but that a third will prove fatal. Tuberculosis is often quiescent during pregnancy: but progress may be rapid before or after parturition. Except possibly in the earliest months, nothing is gained by abortion or premature labour; in first four months, indicated if tuberculosis is (1) active, (2) recently arrested. A tuberculous mother should never suckle an infant.

MARRIAGE.—A tuberculous subject should not marry for at least two years after the cessation of all symptoms of active tuberculosis.

CLIMATE.—Occurs in all climates, but rarer in dry high localities.

TRAUMA.—Data inconclusive. Appears to predispose to tuberculosis of knee-joint. Injury to chest may be followed by active tuberculosis. (*See also* HÆMOPTYSIS.) Relation of head injuries to meningitis also unproved.

Sources of Infection.—(1) Sputum of phthisical persons. Danger mainly from droplets of sputum suspended in air on coughing or speaking. No ejection of bacilli on quiet breathing. (2) Milk of cattle with tuberculosis of the udder. In meat, bacilli are mainly killed by cooking.

Milk: Special Grades (Milk Order, 1936, Great Britain).—

1. **TUBERCULIN TESTED MILK.**—Cows free from evidence of tuberculosis and tuberculin-negative. Milk bacteriologically tested. Either (a) 'certified', raw, or (b) 'Pasteurized'.
2. **ACCREDITED MILK.**—Cows free from evidence of tuberculosis. Milk bacteriologically tested.
3. **PASTEURIZED MILK.**—Bacteria not exceeding 100,000 per millilitre.

Modes of Infection.—Four possible modes: (1) Inhalation; (2) Ingestion; (3) Cutaneous inoculation; (4) Heredity. The first two are of negligible practical importance.

INHALATION.—The main evidences are: (i) Tuberculous sputum supplies factor; (ii) The frequent onset in the lungs; (iii) Pulmonary tuberculosis in adults is caused by the human type of bacillus; (iv) Villemin 1868, Koch in 1884, and others subsequently produced pulmonary tuberculosis in animals by inhalation.

Note.—Husband and wife infections are notoriously rare.

INGESTION.—Infection may occur through (a) tonsil, (b) alimentary canal. The main evidences are: (i) Presence of tubercle bacilli in cow's milk; (ii) Abdominal tuberculosis in children is due to bovine bacillus in 80 per cent.

CUTANEOUS INOCULATION.—Occurs in butchers and post-mortem workers. Lesions usually remain local.

HEREDITY.—Congenital tuberculosis extremely rare: ascribed to infection through placenta, which is usually affected. Infection by spermatozoon or ovum may be neglected.

Paths of Infection in Pulmonary Tuberculosis.—

1. INHALATION.—(a) Direct to small bronchi, or (b) Bacilli penetrate tracheal mucous membrane, thence to tracheo-bronchial glands, thence by blood or lymph to lung tissue.

GHON'S FOCUS IN CHILDREN: EPITUBERCULOSIS.—Ghon (and previously Parrott) showed that in pulmonary tuberculosis in children the primary lesion is a node in lung tissue *due to inhalation*, usually in lower lobe under pleura. From the node, bronchial glands are infected through the lymphatics, and later may produce pulmonary tuberculosis.

Fate of the Node.—(1) May heal, calcify, and may be revealed in later years by radiographs or at autopsy; (2) Inflammatory reaction around, so-called *epituberculosis*, which may (a) resolve completely, or (b) break down into cavity or into fibro-caseous tuberculosis.

ORAL.—Through mucous membrane of mouth, pharynx, or tonsils (without causing lesions) to cervical glands: thence (a) To supraclavicular glands and to apex of lung, or (b) To bronchial glands first.

INGESTION.—Through mucous membrane of intestine to glands, thence by thoracic duct and blood to lungs; mesenteric glands may or may not be affected. Calmette proved this path.

Histology of Tuberculous Lesions.—The tubercle bacillus causes a chronic inflammatory change, a *granuloma*. The typical element is the 'tubercle': this is histologically identical with certain other local chronic inflammations, e.g., actinomycosis.

THE ELEMENTARY 'TUBERCLE'.—On arrival and multiplication of tubercle bacilli the following changes occur: (1) Fixed connective-tissue cells multiply, forming *epithelioid cells*; (2) Polynuclear leucocytes arrive, are destroyed, and are followed by small lymphocytes; (3) Giant cells may form; (4) A fibrillated reticulum may surround cells. A *giant-cell system* thus forms.

GIANT-CELL SYSTEM.—Features: (i) Giant cells near centre; (ii) Some caseation; (iii) A ring of epithelioid cells; (iv) An outer ring of small, mononuclear cells; (v) System is non-vascular; (vi) Tubercle bacilli amongst cells, but scanty; (vii) Often an outer zone of hyperæmia. *Rarely seen typically except when lesion very acute.*

Epithelioid Cells.—Large oval cells with oval faintly-staining nuclei and considerable protoplasm. May contain bacilli.

Giant Cells.—Formed by fusion of several epithelioid cells, or by multiplication of nuclei. Many nuclei gathered together at one end or edge. Rarely contain bacilli (but commonly so in cattle).

Variations.—Giant cells often absent. Epithelioid cells or mononuclear cells are sometimes absent.

Tuberculosis—Histology of Tuberculous Lesions, continued.

GROWTH OF THE TUBERCLE.—

MILIARY OR GRAY TUBERCLE.—By fusion of several elements.

Size of pin's-head, semi-translucent, gray, firm, and projecting.

YELLOW TUBERCLE.—Gray tubercle increases by fusion with others, caseation occurring simultaneously: thus forms yellow tubercle, an opaque yellow mass size of nut surrounded by ring of gray tubercles. Beyond is area of hyperæmia, and, in the lung, proliferated alveolar cells and small bronchi containing desquamated cells and exudation. A tubercle is always *non-vascular*.

SECONDARY DEGENERATIVE CHANGES.—(1) Caseation

(2) Fibrosis; (3) Calcification; (4) Softening.

CASEATION.—Commences in centre of tubercle, a coagulation-necrosis, spreading outwards: cells stain badly, lose outline, and become débris: bacilli scanty or absent, but matter usually virulent on inoculation. Due to action of bacilli or their toxins.

FIBROSIS.—Commences at periphery: proliferation of connective-tissue cells: is result of inflammation set up by tubercle, an effort at repair. Caseation and fibrosis invariably occur. If fibrosis is successful, a capsule is formed and progress of tuberculosis checked, but bacilli in encapsulated caseous matter may be virulent years later if rupture occurs.

CALCIFICATION.—Caseous matter impregnated with lime salts, forming hard and harmless mass, e.g., a lung stone.

SOFTENING.—Caseous matter liquefied by exudation of fluid. Tends to occur near surface of body and where tissues are soft. 'Chronic abscess' results; contains white gritty sterile matter formed of cell débris, not true pus; wall of purplish granulation tissue loosely adherent to surroundings and containing tubercle bacilli.

DISTRIBUTION OF TUBERCLES IN THE BODY.—In adults: especially in lungs. In children: especially bones, joints, and lymph-glands. Rare in stomach, œsophagus, thyroid, and muscles, and unusual in pericardium.

METHODS OF EXTENSION IN THE BODY.—From a focus spread may occur by: (1) Mucous surfaces; thus sputum affects other parts of lung, or, after swallowing, the intestine. (2) Lymphatics. (3) Blood-stream: result may be (a) *local*, e.g., entering branch of pulmonary artery and infecting region of lung, or (b) *general*, e.g., entering pulmonary vein and causing acute general miliary tuberculosis.

II. MILIARY TUBERCULOSIS.

General miliary tuberculosis results when tubercle bacilli enter blood-stream from a primary focus, e.g., an unencapsulated yellow tubercle, and become disseminated—cf. septicæmia. Weigert demonstrated the presence of tuberculosis of blood-vessels in a high percentage, commonest site being the *pulmonary veins* (adherent caseous glands frequently present) and thoracic duct.

TYPES OF GENERALIZED TUBERCULOSIS (Weigert).—Bacilli, without multiplying in blood, settle in organs, producing: (1) *Acute miliary tuberculosis*: (a) All organs affected; (b) Certain organs specially affected. (2) *Chronic generalized tuberculosis*. Rare. Mainly in children. Larger scattered yellow and caseous tubercles.

Acute Miliary Tuberculosis.—

GENERAL CHARACTERISTICS.—(i) Always secondary to some primary local focus; focus may be extremely small. (ii) Febrile course not exceeding a few weeks. (iii) Always fatal. (iv) Most frequent in young children, especially after measles and whooping-cough.

THREE PRINCIPAL CLINICAL TYPES.—(1) *Acute general miliary tuberculosis*: symptoms 'typhoidal'. (2) *Acute miliary tuberculosis of the lungs*: marked pulmonary symptoms. (3) *Tuberculous meningitis*: marked cerebral symptoms. All intermediate forms occur. Development of pulmonary or cerebral type not uncommon in cases commencing as generalized form.

ACUTE GENERAL MILIARY TUBERCULOSIS.

(*Typhoidal Form.*)

Etiology.—*Age*: Usually young: rare over 20 years.

Symptoms.—

ONSET.—Insidious progress of malaise. Gradual development of feverishness, weakness, and wasting. Abrupt onset in rare instances.

PROGRESS.—Characterized by *severe toxæmia with few local symptoms*. (1) *Tongue* and skin dry. Cheeks have cyanotic flush. Loss of weight rapid. Sweating may occur. (2) *Pulse* rapid and feeble: rarely dicrotic. (3) *Temperature irregular*: about 103°: remittent or intermittent: inverse type not uncommon (morning rise). Rarely almost afebrile. (4) *Lungs*: often no changes, may be slight bronchitis. (5) *Spleen* often palpable. Diarrhœa unusual. (6) *Mental condition*: torpor progressing to final coma. Acute delirium rare.

TERMINATION.—Often pulmonary or cerebral symptoms develop (corresponding to other types): or passes through 'typhoidal' state to death in coma.

DURATION.—Usually less than a month: occasionally one to three months.

Diagnosis.—Usually extremely difficult owing to absence of characteristic features. From:—

TYPHOID FEVER.—In tuberculosis:—

- (1) *Temperature irregular*. Pulse rapid. (2) No rose-red rash.
- (3) Specific reactions: agglutination reaction and blood cultures negative. (4) Blood-count: may be polynuclear leucocytosis.

SEPTICÆMIA.—Blood cultures. Septic focus.

INFECTIVE ENDOCARDITIS.—Blood cultures. Cardiac lesions.

HODGKIN'S DISEASE.—Unusual types.

B. ABORTUS INFECTION.—Agglutination reaction (*see p. 96*).

Tuberculosis, *continued*.

ACUTE MILIARY TUBERCULOSIS OF THE LUNGS.

Etiology.—Adults: previous cough or tuberculosis. Children: measles or whooping-cough, or tuberculous disease. May be no factors.

Morbid Anatomy.—Lungs studded with minute gray tubercles; primary caseous focus often at apex or in bronchial glands. Local erosion of a vein may be visible. May be secondary broncho-pneumonia.

Symptoms.—*Marked pulmonary symptoms.*

ONSET.—*As bronchitis*: sputum purulent, hæmoptysis rare.

ESSENTIAL SYMPTOMS.—

Cough	} Severe and out of proportion to physical signs.
Dyspnœa	
Cyanosis	

OTHER SYMPTOMS.—Fever: 102° to 104° : may be inverse type. Rarely afebrile. *Spleen* may be palpable.

Lungs.—Bronchitis only, or nothing abnormal. May be hyper-resonant. In children, often slight impairment of note and bronchial breathing at bases, from collapse.

RADIOGRAPHS.—Fine mottling throughout lungs.

PROGRESS AND DURATION.—*Rapid wasting and weakness.* Symptoms of cerebral type may develop. *Duration*: commonly about two weeks, usually within one to six weeks, in rare instances two months.

Diagnosis.—On essential symptoms, usually aided by etiology. Tubercle bacilli in sputum rare. Choroidal tubercles very rare.

TUBERCULOUS MENINGITIS.

(*Basal Meningitis.*)

Etiology.—*Age*: Commonest from two to five years: rare under one year. No age immune. Secondary to tuberculous focus elsewhere, often bronchial or mesenteric glands; not common directly from pulmonary tuberculosis. May be part of or terminal to generalized miliary tuberculosis.

Morbid Anatomy.—

MENINGES AT BASE AFFECTED.—*Leptomeningitis*, dura mater not involved. Interpeduncular space, optic chiasma, Sylvian fissure affected: may spread over lateral surface and over pons, rarely on upper surface.

MEMBRANES.—Matted together, or purulent exudate, or milky appearance from turbid fluid in subarachnoid space over these areas, and extending along nerves. May be slight thickening only.

TUBERCLES.—Size of pin's head, whitish, scanty or numerous. Situated on (a) membranes, especially in Sylvian fissure; (b) arteries (appearing as nodules), especially middle cerebral and anterior and posterior perforating arteries.

LATERAL VENTRICLES.—Distended with turbid fluid, fornix and septum lucidum destroyed, and convolutions flattened (acute hydrocephalus). Tubercles usually present on choroid plexus and lining membranes.

CEREBRAL TISSUE under affected meninges oedematous and infiltrated with leucocytes, i.e., encephalitis present.

Occasionally: Meninges of cervical cord affected. Caseous tuberculous masses in brain substance.

Symptoms.—Described as they occur in children. Are numerous and variable.

COURSE.—Prodromal period. Followed by *three stages*, not always separable, duration of each about one week: (1) Stage of irritation; (2) Stage of increasing intracranial pressure; (3) Stage of paralysis or coma.

PRODROMAL PERIOD.—May follow measles, whooping-cough, or a fall. Wasting: anorexia: peevishness. Duration about two weeks, or up to six.

FIRST STAGE.—*Stage of Irritation* (of meninges and cortex). Onset often with a convulsion. Essential symptoms at onset are:—

1. Headache: intense: child puts hand to head.
2. Vomiting: cerebral type, independent of food.
3. Fever: 102° to 103° .

Other symptoms developing during this stage:—

4. Pulse: rapid at first but becoming slow and irregular (cerebral pulse).
5. Constipation: invariable.
6. Hydrocephalic cry: short causeless scream: rarely, continuous crying.
7. Pupils contracted.

Also common: restlessness, twitchings of muscles, slight squint, photophobia, fontanelle tense; occasionally marked hyperæsthesia.

SECOND STAGE.—*Stage of Increasing Intracranial Pressure.*

Irritation diminishes, viz., vomiting and headache slight. Lies on side with elbows and knees flexed. Difficulty in swallowing.

1. Drowsy but irritable: resists feeding or moving.
2. Abdomen carinated. Constipation. Rapid emaciation.
3. Ocular changes: (a) Pupils dilated or unequal, reaction to light altered; (b) Movements of eyes may be inco-ordinated; (c) Squint; (d) Early optic neuritis, ptosis.
4. Convulsions, or rigidity: latter may follow convulsions.
5. Temperature: lower, about 100° to 102° .
6. Pulse, slow and irregular: respiration similar, but less marked.

Head retraction not uncommon, but rarely marked.

Tache cérébrale. May be erythemata. Cheeks often flushed.

THIRD STAGE.—*Stage of Paralysis.*

1. Coma, becoming deeper.
2. Motor symptoms: (a) Convulsions; (b) Local spasms; (c) Paralyses; (d) Contractions.

Protein increased ; (2) Small lymphocytes present (*see* PLEURAL FLUIDS), but rarely polymorphs predominate ; (3) Tubercle bacilli usually present, but often difficult to find ; (4) Glucose falls, but does not disappear ; (5) Chlorides fall, usually under 650 mg. per 100. c.c. Lange's reaction may give meningitic response : 0 0 0 0 1 3 4 4 3 0 0. Fluid clear or slightly turbid.

BLOOD COUNT.—Polynuclear leucocytosis : not constant.

TYPHOID AGGLUTINATION REACTION.—Negative : considerable agglutination not uncommon, but titre below 'positive'.

Differences in Adults.—Prodromata rare. Earliest symptoms may be (1) squint (diplopia), (2) aphasia or some alteration in speech, or (3) vomiting. Less commonly (4) monoplegia or hemiplegia, sometimes with aphasia, (5) condition suggestive of hysteria. Delirium, and muscular twitchings and rigidity common, but general convulsions rare. Coma rapid and duration short (about two weeks) : ascribed to unyielding adult skull.

Diagnosis.—Questions are : (1) Is meningitis present ? (2) If so, what is the type ? Important are : (a) *Spinal fluid* (completely diagnostic). Agglutination reaction of serum. (b) Age (rare under one year : commonest 2 to 5 years). (c) Previous tuberculous foci.

1. IS MENINGITIS PRESENT ?—Diagnosis from :—

TYPHOID.—Patient in relaxation, lies on back, abdomen distended. Agglutination reaction develops.

PNEUMONIA.—Especially apical. Pulmonary signs.

ACUTE GASTRITIS.—Tongue furred ; no cerebral signs.

• **ACUTE POLIO-ENCEPHALITIS. ACUTE ENCEPHALITIS.**

OTITIS MEDIA.

ACUTE PYELITIS.—In young children.

In adults, from **INTRACRANIAL TUMOUR**, or rarely **HYSTERIA**.

2. TYPE OF MENINGITIS.—**CEREBROSPINAL MENINGITIS** is the usual type under one year : head retraction marked.

Prognosis.—Always fatal.

Treatment.—Repeated lumbar puncture eases the pain : twenty-four or forty-eight hour intervals. Careful nursing and nasal feeding in later stages prolong life.

III. PULMONARY TUBERCULOSIS.

(Consumption. *Phthisis*.)

Classification.—Pulmonary tuberculosis occurs in following forms :—

ACUTE PULMONARY TUBERCULOSIS.—

- | | |
|--|-------------------------|
| 1. ACUTE PNEUMONIC TUBERCULOSIS | } <i>Acute Phthisis</i> |
| 2. ACUTE BRONCHOPNEUMONIC TUBERCULOSIS | |
| 3. ACUTE MILIARY TUBERCULOSIS OF THE LUNGS | |

CHRONIC PULMONARY TUBERCULOSIS	} <i>Chronic Phthisis</i>
FIBROID PHTHISIS	

Tuberculosis, *continued*.

ACUTE PULMONARY TUBERCULOSIS.

Acute Pneumonic Tuberculosis.

(*Tuberculous Lobar Pneumonia*.)

Very rare. Usually in males.

Morbid Anatomy.—*One lobe*, usually upper, affected, or less often whole lung. *Small cavity* or caseous focus frequent, whence infection has spread probably by bronchi. *Affected area*: solid, heavy, airless, and grayish, resembling hepatization. Miliary tubercles often not obvious. May be tubercles in other lobes of same or other lung or caseous glands, thus revealing condition, even in absence of cavity or caseous focus. If more chronic, may be areas of caseation or excavation: rarely whole lung caseous.

Symptoms.—

ONSET.—Often typical of acute lobar pneumonia.

PROGRESS.—Symptoms and physical signs of typical pneumonia *until crisis fails to occur*. Suggestive symptoms then arising: (1) Irregular temperature; (2) Rapid pulse and severe constitutional disturbance; (3) Persistence of consolidation in lungs.

SUBSEQUENT PROGRESS.—Irregular temperature, rapid wasting, sweats; prostration. Signs of cavitation develop; sputum becomes purulent.

TERMINATION.—May be: (1) Typhoid state and rapid death about two weeks; (2) Gradual failure and death, about two months: usual form. In extremely rare cases, acute symptoms subside and chronic tuberculosis follows.

Diagnosis.—Rarely diagnosed from typical pneumonia until crisis fails. Differences (all of little value) may be: (1) Suspicious family or personal history: and onset less abrupt; (2) Temperature less regular from commencement; (3) Breath-sounds faint rather than tubular: a point much emphasized.

Tubercle bacilli may be found in first week, but rarely under 10 days. Signs of cavitation may give earliest diagnosis.

Acute Bronchopneumonic Tuberculosis.

(*Tuberculous Bronchopneumonia*.)

Commonest form of 'galloping consumption' or phthisis florida, especially in children.

Morbid Anatomy.—

MACROSCOPIC.—

1. Lung studded with *grayish nodules* or, if longer duration, *small caseous masses*, $\frac{1}{4}$ to $\frac{1}{2}$ inch diameter. Miliary tubercles unusual.
2. Scattered *small ragged cavities*. Large new cavities uncommon, owing to short duration.
3. Intervening areas of lung tissue show (a) red pneumonic consolidation, or (b) emphysema or cedema.

4. Old cavity or lesion not uncommon, usually at apex.
5. Bronchi contain purulent secretion.
6. Fibrinous pleurisy present.
7. *Bronchial glands* often enlarged and caseous round root of lung in children. Pneumothorax not uncommon.

Areas may be involved at different sites, *especially both apices*. In other cases, one lobe may be nearly solid, but intervening non-tuberculous portions are nearly always recognizable.

In *children*, when duration short, tuberculous nature of broncho-pneumonia not always recognizable macroscopically. In slower forms caseous areas present.

HISTOLOGY.—The lesion is an acute, caseating bronchopneumonia, commencing in the walls of the finer bronchioles. The nearest alveoli are affected with a catarrhal pneumonia. The tuberculous process and resulting caseation gradually extend. In a small focus, the following changes are present:—

1. *Central bronchiole*.—Walls thickened and caseating. Lumen contains caseous matter.
2. *Alveoli* in immediate neighbourhood destroyed by caseation, with varying degree of fibrosis. Remnants of alveoli may be visible.
3. Surrounding zone of alveoli with thickened alveolar walls and air-spaces plugged with catarrhal products; commencing caseation present in parts.
4. Outer zone of alveoli unchanged, or with evidence of emphysema, cedema, or commencing involvement in focus.

Modes of Onset.—

ADULTS.—

1. Abrupt onset: following overwork or strain, especially in alcoholics.
2. Following influenza.
3. Cough for a period: tuberculous focus, whence spread.
4. Sequel of hæmoptysis: whence aspiration of tuberculous matter into bronchi: generally rapid progress.

CHILDREN.—Often following measles and whooping-cough.

Symptoms.—

ONSET.—Abrupt: rigors, dyspnoea, cough, high temperature, rapid pulse. Sometimes more gradual.

PROGRESS.—*Wasting and weakness marked*, often vomiting.

TERMINATIONS.—

1. Symptoms progress rapidly: hectic temperature, sweats (mainly at night), wasting, and pulmonary symptoms. Typhoidal state may develop, delirium, dry tongue and skin, diarrhoea. Death in three weeks.
2. Less rapid: death about two months.
3. Improvement after some weeks and becomes chronic: rare.

Physical Signs.—Early: diffuse bronchitis, both lungs. Later: areas of consolidation, especially at apex; percussion note impaired, breathing loud or tubular, râles.

Radiographs.—Shadow scattered throughout lung.

Tuberculosis, Acute Bronchopneumonic, continued.

Diagnosis.—

IN ADULTS.—Tubercle bacilli present early in sputum. Severity of symptoms suggestive.

IN CHILDREN.—Usually swallow sputum. Rapid wasting and weakness with bronchopneumonia suggestive.

Acute Miliary Tuberculosis of the Lungs.

(See ACUTE MILIARY TUBERCULOSIS, p. 138.)

CHRONIC PULMONARY TUBERCULOSIS.

(*Fibro-caseous Tuberculosis.*)

Distribution of the Lesions.—

PRIMARY LESION.—*Usual Site*: In upper lobe, 1 to 1½ inch below apex, nearer posterior and external borders. Corresponding points on surface: (a) Anterior: below middle of clavicle; (b) Posterior: supraspinous fossa. Extends downwards thence—on anterior surface, about 1½ inches from sternal line. *Less common site*: Below middle and outer third of clavicle, between 1st and 2nd spaces.

SECONDARY LESIONS.—*Common sites*: (1) Lower lobe of same lung. About 1 to 1½ inch below its apex. Corresponding point on surface posteriorly: opposite 5th dorsal spine. Extends: parallel to interlobar septum, downwards and outwards. (2) Upper lobe of opposite lung. Relative frequency of these two as first secondary lesion doubtful: lower lobe probably usually earlier: almost always infected by the time physical signs are present at apex.

Last site to be affected: Base and anterior portion of lower lobe.

Initial lesion at base: extremely rare in adults. Less rare in children, by extension from enlarged bronchial glands.

Right apex affected somewhat more often than left.

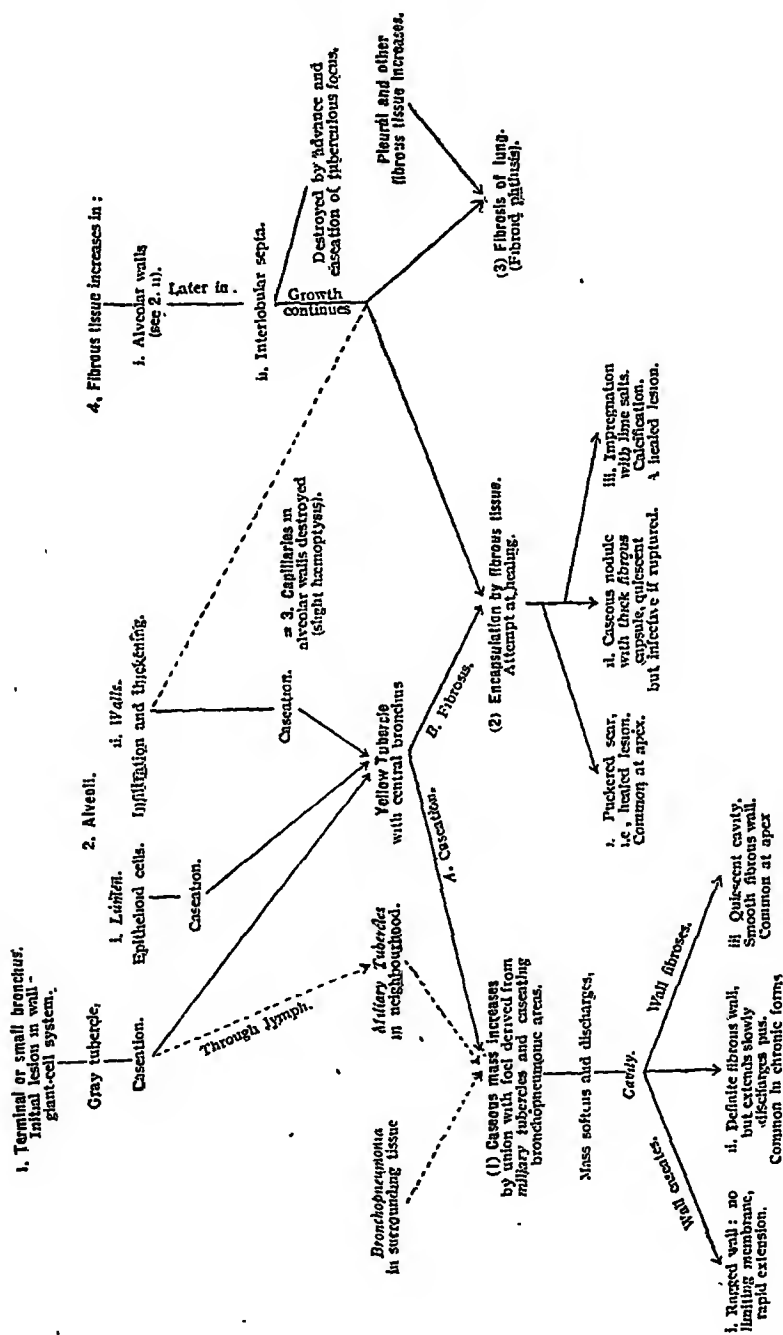
GHON'S FOCUS IN CHILDREN.—See p. 135.

CAUSE OF ORIGIN AT APEX.—*Theories*: (1) Slighter respiratory movement at apex, considered by anatomists to be minimal at exact spot where onset is most common. Results in diminished circulation in capillaries, deficient aeration, and hence weakness of tissues. (2) Connection between apical lymphatics and those of bronchial glands and lymphatic glands of neck.

Mode of Extension.—Spread may be: (1) Direct infiltration in surrounding tissue; (2) By lymphatics and capillaries—(a) peribronchial, producing neighbouring miliary tubercles which fuse with parent mass, or (b) subpleural and interstitial, wider spread; (3) Inhalation of infected material into bronchiole or bronchus. Also by blood-vessels, causing miliary tuberculosis.

Morbid Anatomy (see p. 145).—The lesions are extremely variable, not only in different cases, but also in different lobes of the same specimen and in various parts of the same lobe. The general conditions are:—

MORBID ANATOMY OF CHRONIC PULMONARY TUBERCULOSIS.



Tuberculosis—Chronic Pulmonary—Morbid Anatomy, continued.

1. The essential lesions of tuberculosis (*see* HISTOLOGY, p. 135) are occurring—viz., cellular changes, followed by (a) necrosis (and caseation), or (b) development of fibrous tissue ('fibrosis' or 'sclerosis'). These two sequelæ occur together, and result depends on which predominates, fibrosis tending to heal and necrosis to extend the lesion.
2. Every stage in above development may be found in small area of lung. Thus it may contain every stage of a tubercle, and also at one point fibrosis may predominate, and at another necrosis.

Summary of Usual Development of Chronic Tuberculosis.—

Initial focus : wall of small or terminal bronchiole. Gray tubercle develops. Meanwhile alveoli fill with epithelioid cells. Lesion proceeds to stages of necrosis (commencing centrally), and fibrosis (peripherally). Assuming extension occurs, focus has now : (1) A central bronchiole containing mucus or, later, caseous material from alveoli ; (2) The bronchiole wall and neighbouring alveoli in progressive stages of tubercle formation, necrosis and caseation, and some degree of fibrosis ; (3) A surrounding zone of alveoli showing catarrh, as in bronchopneumonia ; (4) External to this : (a) patches of collapse of alveoli and of 'emphysema' (more correctly, alveolar distension) ; (b) miliary tubercles, spreading from initial focus by lymphatics.

Lesions as affecting Various Tissues of Lung.—

SMALL BRONCHI AND BRONCHIOLES.—Chronic tuberculosis usually commences in wall : elementary gray tubercle forms, as described in HISTOLOGY (p. 135), forming peribronchial tubercle.

ALVEOLI AND ALVEOLAR WALLS.—(1) *Alveoli* : In lobule of affected bronchiole, alveoli fill with epithelioid cells and a varying number of leucocytes, generally scanty. Necrosis of these cells occurs, thus forming a plug within the alveolar walls. (2) *Alveolar Walls* : Early change is cellular infiltration and some thickening of fibrous tissue. Necrosis is, in general, later in walls than in alveolar contents : on occurrence it forms a fused caseous mass with alveolar contents and uniting with the peribronchial tubercle.

Thus at this stage from lumen outwards are seen : (i) *Caseous areas*, consisting of original tubercle fused with the caseated alveolar contents and alveolar walls. May be occasional giant cell. (ii) Area in which alveolar walls are thickened but still present, with caseous contents of air-space. (iii) Area in which alveolar walls show early changes and contents are epithelioid cells.

Subsequent progress (and even extension to this stage) depends on predominance of one or other of the two tuberculous changes :

(1) *Necrosis* : Caseous mass formed. May rupture into bronchus, forming small cavity. (2) *Fibrosis* : Growth of connective tissue from wall of bronchus, alveoli, or interlobular septum may arrest growth at any point, enclosing mass in fibrous capsule.

ARTERIOLES AND CAPILLARIES.—Destroyed by tuberculous progress. *No vessels ever present in tubercles.* Rupture of capillaries causes the slight early hæmoptysis (*see also* CAVITIES).

FIBROUS TISSUE.—*Arrest of tuberculosis.* All fibrous tissue within tuberculous zone tends to proliferate, amount varying with rapidity of spread. May arrest progress and cause 'healing'.

1. In alveolar walls and small bronchioles. May result in :
(a) Subsequent degeneration to a granular débris, uniting with any caseous material; (b) Permanent fibrous tissue and arrest of progress. Not common.
2. In interlobular septa. Similar, but more often permanent. May organize later, with development of new blood-vessels, and, contracting, assist in formation of 'fibroid lung'.

RESULTS OF FIBROUS CAPSULATION and the healing of a focus.—

1. A 'puckered scar': fibrous tissue contracts and tuberculous process arrested. Frequent at apex without other signs of tuberculosis, as remnant of former lesion.
2. Caseous nodule with thick fibrous capsule: central matter still infectious, and rupture may cause acute tuberculosis.
3. Calcification of nodule arising as above, due to subsequent impregnation with lime salts: not infectious: very hard: may become loose and be expectorated as 'lung stone'.

In walls of cavities, fibrous-tissue formation results in slowing or, more rarely, arrest of advance.

LUNG TISSUE OUTSIDE DEFINITE NODULE.—May show:—

1. Catarrhal pneumonia. As in ordinary bronchopneumonia. Accounts for wide area of consolidation in early phthisis. May involve larger portion of lobe. Probably of tuberculous origin. Macroscopic appearance may be: (i) Resembling red hepatization; (ii) Homogeneous and gelatinous, *infiltration tuberculeuse* (Laennec); (iii) Numerous opaque points from degeneration of alveolar contents.
2. Patches of alveolar collapse: from blockage of bronchioles.
3. Patches of 'emphysema'—or (more correctly) distension of alveoli.

CAVITIES.—Caseous matter may soften by ingress of fluid, and then discharge through ulcerated bronchus, thus forming a vomica or cavity. Size varies from small pea to, rarely, whole lobe. Of following types, but all may coexist:—

FRESH ULCERATIVE CAVITY.—Soft ragged wall, no limiting membrane. In acute phthisis often numerous and small.

Also in chronic forms where extension is taking place.

FIBROUS CAVITY.—Wall definitely fibrous but discharges pus. Contents resemble nummular sputum. Strands of blood-vessels or bronchi may persist. Extends slowly. Constitutes largest form.

QUIESCENT CAVITY.—Smooth fibrous-tissue wall. Usually small. Is maximum healing of a cavity.

Fibrous tissue near cavity tends to increase and adjacent pleura thickens. *Pleural thickening* common at apex with one or more quiescent cavities.

BLOOD-VESSELS.—Obliterated by inflammation, but are last tissue affected: thus often persist as strands running through

Tuberculosis—Chronic Pulmonary—Morbid Anatomy, continued.

cavities, with blood circulating. May rupture from (a) erosion of wall, or (b) formation of aneurysms: serious hæmorrhage results.

PLEURA.—Always affected in chronic phthisis. May be:—

1. Dry pleurisy—thin adhesions.
2. Dry pleurisy—great thickening of pleura.
3. Caseous tuberculous masses in pleura.
4. Effusions: clear, hæmorrhagic, or purulent: usually sterile, occasionally pneumococci or pyogenic cocci.
5. Pneumothorax: from rupture of caseous nodule.

BRONCHI.—Inflammation spreads up from small bronchi. Aided by coughing, may result in bronchiectasis. In larger tubes, chronic catarrh.

BRONCHIAL GLANDS.—In acute phthisis, enlarged and œdematous: miliary tubercles and caseous foci. In chronic phthisis: either caseous, hard and calcified, or softened.

PIGMENTATION.—When chronic, some pigmentation of fibrous tissue almost invariable, old lesions being of slaty colour from carbon particles.

Other Organs Affected.—*Tuberculosis* may be present in (arranged in order of frequency): (1) Lymphatic glands, (2) intestines, (3) larynx, (4) spleen. Less common: kidney, brain, liver; pericardium rare, and endocardium very rare.

Classification of Stages of Phthisis.—

TURBAN-GERHARDT CLASSIFICATION.—*First stage*: Physical signs, if unilateral not below second rib; if bilateral, limited to supraclavicular and supraspinous areas. *Second stage*: Physical signs, if unilateral, not below fourth rib; if bilateral, not below second ribs. No excavation. *Third stage*: More extensive disease or cavities. 'Open tuberculosis' is applied to cases with tubercle bacilli in sputum, and 'closed' to those without tubercle bacilli. In the former, tuberculous matter must be in communication with a bronchus.

PHILIP'S CLASSIFICATION.—Subdivides Turban-Gerhardt's stages (referred to as L_1 , L_2 , L_3), according to degree of systemic disturbance: (a) Slight: small s. (b) Marked: large S. (c) In excess of lung involvement: large I. Groups are thus (1) L_1 , L_1S , L_1S , I_1S ; (2) L_2 , L_2S , L_2S , I_2S ; (3) L_3 , L_3S , L_3S , I_3S .

INMAN'S CLASSIFICATION.—Based on temperature (rectal) in relation to exertion: (1) Febrile when resting; (2) Afebrile resting, febrile ambulant; (3) Afebrile ambulant; (4) Afebrile working. Useful clinically.

LONDON COUNTY COUNCIL.—For administrative purposes:—

- A. Cases in which tubercle bacilli have never been found in the sputum.
- B. Cases in which tubercle bacilli have at some time been found.
 1. Slight if any constitutional disturbance. No serious complications. Signs limited to upper zone in unilateral cases and not below clavicle or spine of scapula in bilateral cases.

2. Cases between Groups 1 and 3.
3. Cases with severe constitutional disturbances, grave complications or extensive physical signs.

Three clinical stages formerly described, supposed to correspond to: (1) Growth of tubercles; (2) Caseation; (3) Excavation. Nowadays these are not accepted as accurate or of value.

Symptoms.—

MODES OF ONSET.—

1. INSIDIOUS.—Lesions advance far without symptoms.
 2. BRONCHITIS, or a 'neglected cold on the chest'. Common.
 3. GASTRO-INTESTINAL.—Anorexia. Flatulence. Loss of weight.
 4. ANÆMIA.
 5. ENLARGED CERVICAL OR AXILLARY GLANDS.—May precede pulmonary symptoms for years.
 6. HÆMOPTYSIS.—This may be followed by: (i) Rapid phthisis, from aspiration of infective matter; (ii) Slow development.
 7. PLEURISY.—(i) With effusion: signs may be present after absorption or develop later. (ii) Dry: e.g., friction at apex. (iii) Pneumothorax.
 8. LARYNGEAL SYMPTOMS.—Hoarseness and irritability of throat. Tuberculous laryngitis almost always secondary to lung, but may cause first symptoms.
 9. FOLLOWING CERTAIN DISEASES.—Measles, whooping-cough.
 10. NEURASTHENIA.
 11. TRAUMA TO CHEST.
 12. Rarely, with attacks resembling ASTHMA or MALARIA.
- Note.*—*Acute* pulmonary tuberculosis commences with symptoms of: (1) Pneumonia or bronchopneumonia; (2) Severe general infection.

CLASSIFICATION OF SYMPTOMS.—

LOCAL.—(1) Cough; (2) Sputum; (3) Hæmoptysis. Less frequent are (4) Pain; and (5) Dyspnœa.

GENERAL OR CONSTITUTIONAL.—(1) Fever; (2) Pulse rapid; (3) Sweating; (4) Loss of weight; (5) Loss of appetite. Less definite are: (6) Facial appearance and cyanosis; (7) Clubbing of fingers; (8) Anæmia.

Local Symptoms.—

COUGH.—*Most frequent early symptom*, usually persists throughout. Absence extremely rare. Nothing characteristic. Most at night and early morning. Worst in rapid advance, and disease of larynx and trachea, but no constant relation to severity of lesion. May cause vomiting, especially in the paroxysms. Food may cause attack. *Early stages*: often dry and hacking. *Later*: looser, with sputum. *With cavitation*: often paroxysmal, especially morning. *With laryngeal tuberculosis*: husky and ineffective.

SPUTUM.—May be absent in early stages, but patient may swallow sputum until instructed to expectorate. Not characteristic until late stages, when nummular. Important data are: presence of (a) tubercle bacilli, (b) blood. Albumin usually present.

Tuberculosis—Chronic Pulmonary—Local Symptoms, continued.

CHARACTER.—Varies with stage:—

Early: mucoid, from degenerated epithelial cells.

Later: greenish purulent masses, very suggestive of phthisis.

Cavities present: 'nummular', solid airless masses sinking in water.

AMOUNT.—In rapid cases with much cough may be 500 c.c. daily: with cavities, most in morning.

ODOUR.—Sweetish. Foetid only with complications, e.g., bronchiectasis, gangrene.

BLOOD.—May be present from hæmoptysis.

MICROSCOPIC EXAMINATION.—(i) Tubercle bacilli. (ii) Elastic tissue: proof of destruction of tissue. Nowadays of little importance. Boil with equal amount of 10 per cent caustic soda, dilute with water, and examine deposit.

HÆMOPTYSIS.—Occurs in 60 to 80 per cent of cases, and is seen at two stages:—

EARLY STAGE.—Amount small, sputum streaked: from eroded capillaries. Never fatal, but often early symptom.

LATER STAGES.—From cavities: may be profuse. Source: (1) Aneurysm on vessels, e.g., pulmonary arteries, size from pea to orange; (2) Rupture of vessel persisting in cavity, less often. *Occasionally, though rarely, fatal.*

MODE OF OCCURRENCE.—

Onset usually sudden, salt taste in mouth; may follow mental excitement or exertion. Patient aware of origin from lungs. Causes great mental alarm and depression.

Characters: red, frothy, alkaline. Occasionally swallowed and, later, vomited.

Sputum tinged for several days subsequently.

*Recurr*s usually several times.

Sequelæ may be: (1) Rise of temperature few days later; (2) *Rapid progress of phthisis* (spread by aspiration of blood into other bronchi).

RELATION OF HÆMOPTYSIS TO TUBERCULOSIS.—True hæmoptysis is most frequently of tuberculous origin. Three groups recognizable when occurring in persons previously considered healthy:—

1. Physical signs and tubercle bacilli already present. Inquiry reveals previous ill-health.
2. No physical signs or tubercle bacilli, but these appear shortly after.
3. No subsequent ill-health or symptoms (about 15 per cent). Probably all are of tuberculous origin.

When following trauma to chest or severe exertion, groups are similar, about half becoming tuberculous.

PAIN.—Some pain not uncommon, but usually slight:—
From pleurisy: usually felt over lower thorax, occasionally apex or scapula.
Vague pains, probably muscular from coughing.

DYSPNŒA.—Slight in early stages; later varies with extent of lung involved.

Occurs with complications: (1) Outbreak of acute miliary tubercles; (2) Bronchopneumonia, or emphysema; (3) Pneumothorax; (4) Cardiac failure, as in fibrosis of lung.

General or Constitutional Symptoms.—

FEVER.—*Valuable measure of severity and progress of the disease. Varies with extent and activity of disease and amount of exercise.* Due to absorption of toxins, i.e., auto-inoculation, resembling tuberculin injection.

Records should include waking, 1 p.m., and 6 p.m.; maximum usually between 4 and 6 p.m. or up to 9 p.m.: taken either in mouth or rectum.

Rectal temperature: difference from mouth temperature varies with individual, but remains fairly constant, average 1° higher (range about 0.6° to 1.8°).

Early stages: temperature continuous or remittent, range varies with severity. Effect of rest of great importance; rapid fall favourable. With rest in bed, even an occasional temperature of 99° in the mouth (e.g., three in 14 days) is a sign of activity of disease.

Inverse type (higher in the morning) not uncommon.

Later stages, caseation and cavity formation: *intermittent* 'hectic' temperature. Rises to 104°. Maximum at 6 p.m. Falls to normal in morning with sweating.

Effect of exercise: When temperature at rest is normal, after gentle exercise rectal temperature may be 101° (even in healthy persons); should fall to normal in half hour. *With active disease* may persist 2 to 3 hours, from auto-inoculation. *Rise continuing after cessation of exercise* is sign of excessive auto-inoculation.

PULSE.—Rate increased: may persist when temperature normal if disease active, and hence of importance. With active phthisis is rarely below 84.

SWEATING.—Often drenching, especially during night and early morning. Sometimes early symptom. In later stages very distressing. Are 'slumber' rather than 'night' sweats.

LOSS OF WEIGHT.—Often early and pronounced. Weight is important index of disease. Loss of strength also present.

LOSS OF APPETITE.—Usually early: especially for fat. Extreme nausea and vomiting not uncommon.

FACIAL APPEARANCE.—Pallor common. Cyanosis not early. In later stages 'hectic' flush occasionally.

CLUBBING OF FINGERS.—Important from easy recognition, but rare in early stages. Pulmonary osteo-arthritis rare.

ANÆMIA is common but not constant in early stages: hypochromic. The leucocytes are normal, or diminished in number.

Physical Signs in the Lungs.—

EARLY SIGNS.—Condition is apical bronchitis with surrounding small areas of consolidation (*Turban's First Stage*). (1) *Fine*

Tuberculosis—Chronic Pulmonary—Physical Signs, continued.

crepitations at apex, localized and persistent, and not removed by coughing. Commonest first sign. Other early and sometimes initial signs: (2) Slight delay or deficiency of expansion and flattening at apex (less frequently initial sign); (3) Percussion note slightly impaired; (4) Breath-sounds diminished, or, less often, harsh, with prolonged expiration.

LESION PROGRESSING, but still early.—Consolidation increasing; other lobes also showing early signs (*Turban's Second Stage*). (1) Deficient expansion and flattening; (2) Impaired note; (3) *Crepitations*; (4) Breath-sounds more definitely harsh and expiration prolonged; also (5) Whispering pectoriloquy and bronchophony. Early signs usually commencing to make their appearance at other sites.

LESION WELL DEVELOPED AT APEX.—Caeation, softening, pleura affected (*Turban's Second or Third Stage*).

INSPECTION AND PALPATION.—Clavicle prominent, flattening of apex, deficient expansion.

PERCUSSION.—Impaired note.

AUSCULTATION.—Breath-sounds more tubular. Râles louder and larger. Whispering pectoriloquy and bronchophony. Signs usually progressing at other sites.

CAVITY.—See p. 154.

Physical Signs according to Methods of Examination.—

INSPECTION.—

1. **ALTERATIONS IN EXPANSION AT AFFECTED APEX.**—(i) Delayed movement, often very early; (ii) Deficient expansion, also may be early.
2. **FLATTENING AT APEX.**—From muscular wasting, fibrotic contraction, and pleuritic adhesion. As early sign, rare. May remain from healed lesion, with other signs slight or absent.
3. **CLAVICLE PROMINENT.**
Other changes may be (not early):—
Wasting of shoulder-girdle muscles. Slight scoliosis.
Diminished expansion of affected side, shown by measurement.

NOTES ON INSPECTION.—

Phthisis frequent with any form of chest, but two special types described: (i) 'Alar' or 'pterygoid' chest, long and narrow, costal angle acute, ribs dropped, scapulae 'winged'; (ii) 'Flat' chest, anteroposterior diameter small. Sternum often depressed and costal cartilages prominent. Inspection signs may be accentuated by deep breathing. Inspection and palpation may suggest but never diagnose early stage.

Expansion of apices best tested from behind.

PALPATION.—Confirms inspection.

VOCAL FREMITUS.—Increased throughout disease except with much pleural thickening or with effusion.

PERCUSSION.—

EARLY STAGE.—*Slightly impaired note.* Often present on first examination, confirming râles. Earliest over clavicle, middle and inner third, and just above and below: posteriorly, in suprascapular fossa and interspinous area (lower lobe, usually in 'second' stage).

CONSOLIDATION INCREASES.—Dullness becomes more definite.

CAVITY.—As cavity forms, dullness may diminish (*see p. 154*).

VARIATIONS AND SPECIAL DIFFICULTIES.—In early stage, note may be within normal limits though foci and crepitations are present, owing to intervening lung tissue. Lung may be emphysematous, giving more resonant note than normal.

With small cavities at apex, note may be normal but with definite auscultatory changes, or may be hyper-resonant.

Impaired note with feeble breath-sounds results from pleural thickening and some consolidation.

NOTES ON PERCUSSION.—

Light percussion reveals the slighter changes.

Compare sides in same phase of respiration: test in full inspiration, also in full expiration if doubtful.

Apex above clavicle: percuss from behind.

Myotatic irritability common in advanced cases: of no diagnostic value.

Krönig's Apical Resonance Areas (practical value not fully established).—Normal band of resonance passes from above clavicle over shoulder, mapped by very light percussion. Width two inches at narrowest part. In phthisis: (a) Isthmus becomes narrower; (b) Margins blurred, especially inner.

AUSCULTATION.—

1. BREATH-SOUNDS.—

Earliest changes.—(a) Feeble, especially inspiration, with expiration prolonged: bronchial inflammation results in lobular collapse and lessened air entry. (b) *Harsh with expiration prolonged*: due to consolidation. Either may precede crepitations and dullness, (a) more frequently. 'Cog-wheel' rhythm frequent, but also in nervous people: not diagnostic: due to interrupted respiration.

Later.—Inspiration harsh, expiration prolonged.

Consolidation.—Bronchial or tubular breathing. (Râles.)

Cavity.—Loud breath-sounds (*see p. 154*).

Unaffected portions of lung.—Harsh or puerile.

2. ADVENTITIOUS SOUNDS.—

Early change.—*Persistent fine crepitations* at apex on inspiration. Most frequent first sign. Termed 'sub-crepitant' since, coming from bronchi, they are less fine than Laennec's 'crepitant' râles of pneumonia. Auscultate on: (1) quiet respiration; (2) deep inspiration; (3) 'cough and deep breath'. Characteristic are: *crepitations localized to one area, persistent on repetition,*

Tuberculosis—Chronic Pulmonary—Physical Signs, continued.

and not removed by coughing, i.e., proof of apical bronchitis. *Note.*—Negligible: Crepitations on first deep breath, disappearing on repetition.

Caseation and softening.—Râles louder and bubbling, i.e., moist sounds. (Percussion note impaired.)

Cavity.—Râles loud and resonant, especially on coughing, may be metallic or amphoric. Absent if cavity dry (rare).

3. **VOICE-SOUNDS.**—Increased throughout disease.

Whispering pectoriloquy and bronchophony.—Especially above clavicles; early suggestive signs, due to consolidation.

Cavity.—Above greatly exaggerated (*see below*).

OTHER AUSCULTATORY PHENOMENA.—

PLEURAL RUB.—May be early at apex, or at any stage.

CARDIO-RESPIRATORY SYSTOLIC MURMUR.—Due to heart expelling air from lung tissue; occurs in early tubercle or in large cavities, and also in *normal thin or nervous people*. Best heard anteriorly during inspiration.

Lappet of lung over heart may cause: (i) If consolidation, *clicks* synchronous with heart-beat, due to compression by heart; (ii) *Pleuro-pericardial rub*.

INCREASED CONDUCTION OF HEART-SOUNDS toward diseased apex.

SYSTOLIC MURMUR IN SUBCLAVIAN ARTERY.—Ascribed to pressure by thickened pleura.

Physical Signs of Cavity.—

INSPECTION.—Flattening of chest wall.

PERCUSSION.—*Note altered*, either impaired (or even dull), or tympanitic if cavity large. Occasionally: (1) Practically normal, if pleural thickening and consolidation are slight; (2) 'Cracked-pot' sound, large cavity auscultated while mouth open (uncommon); (3) Amphoric, very large cavities; (4) Wintrich's sign, note varies with mouth open or closed (little value).

AUSCULTATION.—

BREATH-SOUNDS.—Altered: 'blowing' or tubular, cavernous or definitely amphoric, according to size of cavity.

ADVENTITIOUS SOUNDS.—Râles, bubbling or crackling. May be metallic tone and amphoric echo. 'Bell sound' very rare. Cavity may be dry, and râles absent.

VOICE-SOUNDS.—Vocal resonance, especially cough, and *whispering pectoriloquy* exaggerated greatly.

POST-TUSSIC SUCTION.—On drawing a deep breath after a cough, a hiss is sometimes audible as air enters cavity through narrow orifice. Most valuable sign when present, distinguishing cavity from consolidation.

NOTES ON CAVITY.—(i) Diagnosis depends on auscultation, especially post-tussic suction; (ii) Consolidation near large bronchus causes closely similar signs (pseudocavernous).

FIBROID PHTHISIS.**(Fibroid Lung.)*

Commonly the slowly developing sequel of chronic tuberculosis, especially associated with pleurisy. Onset and progress insidious and very chronic.

Symptoms.—Slight: chronic for ten or twenty years. (i) *Cough*, often paroxysmal. (ii) *Dyspnœa on exertion*. (iii) *Sputum purulent*: may be foetid.

Physical Signs on Affected Side.—Very characteristic: *Diagnosis mainly by inspection and palpation*. Little difference between non-tuberculous and tuberculous forms, but in latter case *cavities common at apex, and often changes in opposite lung*.

INSPECTION, MEASUREMENT, AND PALPATION.—Thorax asymmetrical. Scoliosis common. Affected side diminished in volume: often markedly. Chest sunken. Shoulder lower. Expansion slight. Apex beat greatly displaced. Heart impulse often increased (especially left lung). Tactile vocal fremitus increased or diminished (pleura thickened).

PERCUSSION.—Impaired, but dullness rarely marked, varies with cavitation and thickness of pleura. Cardiac dullness displaced. Opposite lung hyper-resonant.

AUSCULTATION.—Breath-sounds usually feeble and bronchial, but vary with cavitation. Adventitious sounds vary with cavitation and bronchiectasis. Voice-sounds diminished, except over cavity. Cardiac murmurs common (partly from displacement of heart).

VARIOUS FORMS OF PULMONARY TUBERCULOSIS.

Emphysema.—Tuberculosis may develop in subject of emphysema and chronic bronchitis. Diagnosis of tubercle difficult; *suggested* by wasting, occasionally areas of dullness, and also by hæmoptysis, and *proved by pressure of tubercle bacilli*; radiographs.

Pleuritic Form.—*Tuberculosis frequently commences with pleurisy*; may be dry or with effusion, onset insidious or acute. Thickened pleura alone may remain. May be recurrent.

In Old Age.—Usually latent, with slow course. Often masked by emphysema and chronic bronchitis. Revealed by tubercle bacilli.

In Infancy.—Chronic tuberculosis unusual. Acute tuberculosis more frequent than in adults.

Hilum Tuberculosis.—In children, pulmonary tuberculosis may arise by extension from tuberculous glands at the root of the lungs, constituting *hilum tuberculosis*. Symptoms and signs slight: diagnosis by radiographs. In adults, very rare.

Epituberculosis.—An inflammatory reaction around a tuberculous focus, e.g., Ghon's focus (see p. 135). Appears in radiographs as triangular shadow with apex at hilum and base at surface of

* See also FIBROSIS OF THE LUNG.

Tuberculosis—Chronic Pulmonary—Epituberculosis, *continued*.

lung, often in axilla. Progress may be: (1) complete resolution, not uncommon; (2) mainly resolves, focus persists; (3) advances to chronic tuberculosis. Possibly may be produced by swelling of gland in hilum pressing on bronchus and causing temporary collapse.

COMPLICATIONS OF CHRONIC PULMONARY TUBERCULOSIS.

Respiratory System.*—

LARYNX.—Often affected. Important from distressing later symptoms. Due to direct inoculation from sputum.

FREQUENCY.—At autopsy about 50 per cent; during life symptoms in about 20 per cent.

SYMPTOMS.—Early, huskiness. Later, extreme dysphagia; also aphonia or ineffectual cough (*see* TUBERCULOUS LARYNGITIS).

EMPHYSEMA.—Common and may mask foci. Frequent in the unaffected (or less affected) lung.

PLEURA.—Adhesions often form without symptoms. Symptoms occur from:—

1. Dry pleurisy.

2. Pleurisy with effusion: More common at onset than during course, but may be recurrent. During course is rarely hæmorrhagic.

3. Tuberculous empyema: Due to liquefaction of caseous mass.

BRONCHIECTASIS.—Common in fibroid phthisis.

PNEUMOTHORAX.—*See* PNEUMOTHORAX.

GLANDS.—Bronchial, mediastinal, and tracheal glands often affected (*see* p. 165).

BRONCHOPNEUMONIA.—Common, and serious, from sudden extension from a focus through lymph, blood, or bronchus.

Cardiovascular System.—

HEART.—Often small. Blood-pressure low. Hypertrophy with fibroid lung. Hæmic murmurs not uncommon. Tuberculous endocarditis extremely rare.

PERICARDITIS.—Very rare, but occurs. *See* PERICARDITIS.

Alimentary Canal.—

TONGUE.—Occasionally shallow tuberculous ulcers, direct infection by sputum. Very painful.

ÆSOPHAGUS AND STOMACH.—Infections of great rarity.

ANOREXIA.—Very early symptom; especially for fats. *Nausea and vomiting* in later stages; may follow cough.

INTESTINE.—Diarrhœa is a frequent late symptom. May be due to: (1) Intestinal catarrh—main cause. (2) Tuberculous ulceration, usually in last few feet of ileum, but may be anywhere: most frequent site of secondary infection (in 75 per cent of post-mortems). Rarely perforates. (3) Amyloid disease.

* For further details, *see* TUBERCULOUS LARYNGITIS, PNEUMOTHORAX, etc.

TUBERCULOUS PERITONITIS.—Rare in phthisis.

FISTULA IN ANO.—Common: tuberculous origin.

Nervous System.—*Organic lesions uncommon.* Include: tuberculous masses, most frequently in cerebellum; tuberculous meningitis. Hopefulness traditionally present in last stages ('*spes phthisica*'). Neurasthenia and depression more common and may be troublesome.

Genito-urinary System.—Genito-urinary tuberculosis uncommon in chronic phthisis. Albuminuria may be: (1) Febrile; (2) Amyloid disease; (3) Rarely nephritis. *Amenorrhœa* common.

Blood.—Secondary anæmia develops, but is not usually an early symptom. Leucopenia in early stages; Arneth count shifts to the left; polynuclear leucocytosis in later stages.

Bones and Joints.—Secondary disease uncommon. Chronic arthritis not infrequent, ascribed to lowered resistance.

Cutaneous System.—Pigmentation occurs occasionally: less frequent than with peritoneal tuberculosis. Pityriasis versicolor common.

Amyloid Disease.—(1) Kidney: polyuria, albuminuria, casts. (2) Intestine: diarrhœa. (3) Spleen and liver: enlarged.

Concurrent or Secondary Infections.—Various bacteria, especially *pneumococci*, *streptococci*, and *Micrococcus catarrhalis*, present in sputum. May cause toxic symptoms.

DIAGNOSIS OF CHRONIC PULMONARY TUBERCULOSIS.

The difficulty occurs in the early cases.

Diagnosis rests on: (1) Symptoms and history; (2) Physical signs; (3) Sputum; (4) Specific tests; (5) Radiographs.

In doubtful cases, patient should be under observation in bed.

Symptoms.—Of greatest importance in diagnosis are:—

Loss of WEIGHT, of strength, and of appetite.

COUGH, persistent. *Sputum*.

HÆMOPTYSIS.

NIGHT SWEATS.

FEVER.

PULSE.—Rapid.

Symptoms similar to some of above occur in: dyspepsia, neurasthenia, debility, early Graves' disease with tachycardia, acidosis.

Physical Signs.—Earliest are: changes in breath-sounds, crepitations, and slightly impaired resonance at the apex. Slight signs must be accepted with special caution in absence of symptoms. Physical signs may be suggestive in many pulmonary lesions, e.g., asthma, chronic bronchitis, bronchiectasis, emphysema, fibrosis, neoplasms, pleurisy.

Tuberculosis—Chronic Pulmonary—Diagnosis, *continued*.

Tubercle Bacilli in Sputum.—Presence is conclusive. Not always present, and absence does not exclude. When sputum is purulent in tuberculosis, bacilli nearly always present; absence on repeated tests is then against tuberculosis.

Specific Tests.—Tuberculin tests possess objections: (1) Positive reaction is not proof of activity; (2) Positive reactions may be dangerous. *Mantoux's intradermic test* is best: inject 0.1 c.c. of 1-10,000 old tuberculin (0.01 mgm.); red areola in 24 to 72 hours is positive (vesiculation and ulceration rarely in sensitive subjects). Negative reaction is against tuberculosis; positive is of little value. Von Pirquet's cutaneous test is of less value.

The following tests have been abandoned: (1) Subcutaneous 'tuberculin reaction': Koch's original method. (2) Wright's opsonic index. (3) Calmette's ophthalmic reaction. (4) Complement-fixation test. (5) Agglutination. Sedimentation test useless for diagnosis.

Radiographs.—For diagnosis, must be interpreted in conjunction with symptoms and physical signs. Evidence as to *activity* often indefinite. Radiographs essential in observing progress and for decision as to operative measures.

SCREENING.—Evidence of: (1) Lighting up of apex with inspiration; (2) Restriction of movements of diaphragm.

FILM.—Exhibits extent of lesions, pleural effusions, pneumothorax. Evidence of activity from: (a) cavities (may show fluid level); (b) areas of consolidation. Pleural or annular rings are cavities. Heart shadow: often narrow and vertical.

'ROOT SHADOWS'.—To be interpreted with caution, especially shadows radiating from hilum; with increasing age, shadows normally present. Bronchial glands: often recognizable.

GHON'S FOCUS.—May be visible in children.

ASSMANN'S FOCUS.—Focus, about half-inch diameter, usually in subclavicular region, in early tuberculosis.

ACCESSORY LOBE OF THE AZYGOS VEIN.—Forms comma-shaped shadow near sternum above third right rib.

Note.—Tomography better reveals localized lesions.

PROGNOSIS OF CHRONIC PULMONARY TUBERCULOSIS.

Numerous features must be considered in forming a prognosis in an individual case, but in general: (1) Activity is more important than extent of lesions; (2) Temperature is the best measure of activity; (3) Response to treatment is best guide to prognosis.

Personal Features.—

FAMILY INCIDENCE.—Unfavourable only with close relatives.

AGE.—Infants and young children, bad.

SEX.—No influence except in pregnancy.

PHYSIQUE.—Poor physique bad.

TEMPERAMENT.—Adherence to treatment and after-care need patience and placidity.

HISTORY.—Alcohol, syphilis, congenital heart disease: bad. Mitral stenosis appears favourable.

OCCUPATION.

Symptoms.—

TUBERCLE BACILLI IN SPUTUM.—Absence is best prognosis, also disappearance under treatment.

COUGH.—Disturbs sleep if persistent.

TEMPERATURE.—Is guide to activity of disease. Persistently febrile in bed: bad. Afebrile working: best.

HÆMOPTYSIS.—Early streaks may cause early diagnosis, gives better prognosis. Later profuse hæmoptysis spreads disease.

PERSISTENT NIGHT SWEATS, EARLY ANOREXIA, TACHYCARDIA, LOW BLOOD-PRESSURE, ALBUMINURIA.—Unfavourable.

Physical Signs.—Activity more important than extent of lesions.

CAVITIES.—(1) Dry cavities, even unclosed: may live many years. (2) Open cavities with purulent sputum and tubercle bacilli: life one or two years unless cavities become closed and activity arrested. (3) Fibroid type with no toxic symptoms: many years.

VITAL CAPACITY.—Is definitely lowered in pulmonary tuberculosis. Best if: (1) nearly normal; (2) improves under treatment; (3) constant while leading ordinary life.

SEDIMENTATION RATE.—Rate increased during activity. Assists as guide to progress.

Complications.—Tend greatly to increase gravity.

LARYNGITIS.—Serious.

PNEUMOTHORAX.—If lesions extensive, pyo-pneumothorax develops and is fatal. Early spontaneous form: may be beneficial.

PLEURAL EFFUSION.—Not unfavourable.

CATARRHAL INFECTIONS.—Tend to spread infection.

EPIDIDYMITIS.—Does not affect prognosis.

MENINGITIS, PERITONITIS, ENTERITIS.—Fatal.

PROPHYLAXIS.

Prophylactic measures include:—

1. Prevention of infection: (a) Human—disinfection, segregation, and treatment; (b) Bovine: treatment of milk-supplies.
2. Hygienic surroundings.

Inoculation with B.C.G. Vaccine (Bacilli Calmette-Guérin).—Is a live vaccine from an attenuated strain. Three doses by mouth given to infants during first 10 days of life. Results at present uncertain.

TREATMENT OF CHRONIC PULMONARY TUBERCULOSIS.

Measures of Progress.—Improvement indicated especially by changes in :—

1. TEMPERATURE.
2. WEIGHT.
3. PULSE.
4. PHYSICAL SIGNS.
5. PRESENCE OR DISAPPEARANCE of tubercle bacilli in sputum.
6. RADIOGRAPHS.
7. SEDIMENTATION RATE.—Is useful in judging progress.

General Treatment.

Rest.—‘Absolute rest’ in bed for all *acute and febrile cases* until temperature normal: allowed up when temperature normal for 3 days. Place in bed with ordinary rest if temperature reaches 99° when patient is up.

Throughout treatment: one hour recumbent rest before lunch and dinner.

Fresh Air.—Windows in room open day and night, sufficient for plentiful fresh air: not shut for cold or rain, or fever, cough, or other symptoms. Patient must never be cold, and must be warmly but not heavily clothed.

Hospital or Private Home.—For early febrile cases; in bed.

Sanatorium.—For chronic cases and early cases after febrile period. Stay at least 6 months or until sputum free of bacilli. Routine to be continued subsequently.

Diet.—Sufficient to cause gain in weight: increase gradually to about 3000 calories a day. Forced feeding prejudicial. An ordinary diet is best and should be given even when patient is febrile. Insulin sometimes helpful.

GERSON'S DIET.—No salt even in cooking; little carbohydrate.

GAIN IN WEIGHT.—Weekly gain desirable, 12 to 20 ounces; may be more for first weeks of treatment, afterwards rapid gain inadvisable; regulated by reducing milk. Too fat patients do badly. Final weight after treatment aims at one stone above previous best weight.

Graduated Exercise.—Amount of exercise strictly prescribed. Commences with few yards on level, slowly, without talking: distance gradually increased: then on slight incline. Further period of light work, as in a garden, systematically increased. After many months' progress, walks may become 10 to 12 miles daily.

Temperature.—Is guide to progress of exercise. After rest of one hour following exercise, must not exceed 98·6° in rectum: if so, reduce exercise or return to bed. If temperature continues to rise after exercise, severe auto-inoculation has occurred.

Climate.—Main types are :—

SEA COAST.—Inadvisable for ordinary phthisis. Suitable for chronic cases with laryngitis, bronchitis, or emphysema. Places : South Coast of England, Bournemouth, Torquay, etc. ; Florida ; Canary Islands, Madeira, West Indies.

DRY, WARM CLIMATES.—Very suitable for all types if sand and dust avoidable. Places : South California ; Algiers (Biskra) ; Egypt (Assouan, Luxor).

MODERATE ALTITUDES.—Woodlands. Numerous and easily accessible ; best for ordinary phthisis. Places (among many equally good) : New Forest ; Scotch Highlands ; Adirondacks ; Pyrenees.

HIGH ALTITUDES.—

Suitable : Early afebrile or advanced quiescent cases.

Unsuitable : Active stages with fever, recent hæmoptysis ; cases with emphysema, asthma, advanced fibrosis ; cardiac or renal complications.

Advantages : Sunshine, pure air, equable temperature.

Disadvantages : Increased respiratory movements tend to produce emphysema, disadvantage on subsequent return to low level : also such movements may spread the disease in the lungs.

Places (among many others) : Davos, St. Moritz, Arossa, Leysin, Colorado Springs, Arizona.

Sea Voyage.—Only in complete convalescence.

Tuberculin.—Use now almost abandoned. Considerable risk. No definite proof of benefit in any form.

Drugs.—No specific drugs known. Most useful are :—

COD-LIVER OIL.—Indications : (1) Full diet unobtainable (e.g., working men) ; (2) Weight not being gained on full diet. Give *small* dose, \mathfrak{z} j to \mathfrak{z} iv, after meals ; stop if causing nausea ; combines well with malt.

MALT EXTRACT.—Good effect in weak digestion.

ARSENIC.—Specially if anæmia marked.

Special Methods of Treatment.

Operative Measures.—(1) Artificial pneumothorax ; (2) Evulsion or crushing of phrenic nerve ; (3) Thoracoplasty ; (4) Apicolysis.

Artificial Pneumothorax.—

INDICATIONS.—(1) Unilateral disease with pyrexia after several weeks in bed or with renewal of signs of activity on getting up or moving ; (2) Repeated hæmoptysis ; (3) Selected bilateral cases with activity mainly in one lung. Not specially indicated in early cases and with favourable progress, but may be employed.

OLEOTHORAX.—Dangerous owing to subsequent infection.

CONTRA-INDICATIONS.—Extensive bilateral disease. Emphysema or cardiac complications (dangerous). Impracticable with old dense adhesions.

Tuberculosis—Chronic Pulmonary—Treatment, *continued*.

AMOUNT OF AIR AND REFILLS.—When needle is in pleural space, oscillations of manometer register the negative pressure: normally -10 to -5 mm. water. Allow to enter sterile air, 200 to 300 c.c.: note pressure. In first week repeat about three times; initial intrapleural pressure will be about 1 cm. higher each time. Then lengthen intervals between injections progressively to 1, 2, and 4 weeks: volume of air about 500 c.c. each injection. At each injection raise pressure 4 cm. above commencing pressure. After three months, pressure about +20 cm. water, being sufficient to collapse lung against spine. Should not exceed +25 cm. Subsequently interval between injections about six weeks, watching physical signs of pneumothorax.

RESULTS.—Very successful in selected cases. Continue refills for 3 years: then allow to expand if condition satisfactory. *Note:* Pleural adhesions always form after expansion, and collapse cannot be repeated.

ADHESIONS.—Prevent effective collapse. Cut by electrocautery through thoracoscope.

DANGERS.—Death from pleural shock: very rare; anæsthetize pleura fully.

Evulsion or Crushing of Phrenic Nerve.—Paralysed diaphragm rises: causes basal collapse, also some relaxation at apex, thus aiding closure of a cavity. Crushing causes temporary paralysis for 6 months (sometimes useful before thoracoplasty).

Thoracoplasty.—Consider in suitable cases if artificial pneumothorax impracticable. Gives permanent collapse.

Apicolysis.—Parietal pleura is separated from chest wall and collapse over a local area of disease produced by introduction of paraffin or similar substance.

Sanocrysin.—Double thiosulphate of gold and iron. Value still under discussion. Effects most promising in: (1) Chronic cases in indolent stationary stage; (2) Symptoms lost under treatment but tubercle bacilli still present. *Initial dose:* intravenous injection 0.05 gm. in sterile saline solution; increase gradually about weekly intervals to 0.25 gm. (or rarely 1 gm.). *Reactions:* fever, albuminuria, diarrhoea, skin; may be severe, especially dermatitis (may be fatal).

Treatment of Symptoms and Complications.

Fever.—Should rarely be interfered with directly: best treated by rest (*see* GENERAL TREATMENT). Above 103°, tepid sponging may relieve. In later hectic stages, reduction of temperature usually fails to improve patients. All drugs to be used with caution: best—phenazone, acetanilide, quinine.

Night Sweats.—Sponge at bedtime with vinegar and water or with alcohol (Eau-de-Cologne): rub dry. Pill of ext. belladonnæ gr. $\frac{1}{4}$ and zinc. oxid. gr. ij to iij rarely effective.

Cough.—Routine use of expectorants prejudicial. Loose cough, bringing up sputum, is beneficial.

INEFFECTIVE COUGH.—Trochiscus glycyrrhizæ (Brompton cough lozenge) is valuable :—

R	Ext. Glycyrrhizæ	gr. iij	|	Troch. Acaciæ	gr. x
	Olei Anisi	℥ ss			
		Occasionally.			

Or sedatives : morphia or heroin :—

R	Liq. Morph. Hyd.	℥ xx	|	Syr. Limonis	℥ xx
	Acid. Hydrocyan. Dil.	℥ iij	|	Glycerinum	ad 3j

Or,

Heroin gr. $\frac{1}{12}$ (for linctus *see* BRONCHITIS).

DRY HACKING COUGH.—Often under patient's control. Patient taught to hold breath and urged to restrain cough.

MORNING PAROXYSMS.—Sputum often tenacious. Saline mixture often useful :—

R	Sod. Bicarb.	gr. x	|	Spt. Chloroformi	℥ x
	Sod. Chlor.	gr. iij	|	Aq. Anisi	3jss

In hot water : on waking.

Gastro-intestinal Disturbances.—Change of diet.

ANOREXIA.—Bitters before meals, or mixture :—

R	Sod. Bicarb.	gr. xv	|	Em. Chloroformis	℥ x
	Tr. Nuc. Vom.	℥ v	|	Inf. Gent. Co.	ad 3j

Acids sometimes effective : also pepsin ferments or bismuth.

Reduced diet may be necessary ; raw meat juice is then valuable.

DIARRHŒA.—Should never be neglected : often troublesome and rapidly debilitating.

LIGHT DIET. WARMTH to abdomen and extremities. BED if necessary.

DRUGS.—Dover's powder, bismuth, or starch and opium enema.

Pain.—If muscular from strain of coughing, rub with liniment of aconite, belladonna, and chloroform.

Insomnia.—Warm drink at night. Sedatives for cough. Mild hypnotics.

Dyspnœa.—Rarely severe, except in late stages or very rapid progress. Stimulants, e.g., ammonia and ether.

Cavities.—Special indications :—

1. CAVITY FOUND ONLY BY RADIOGRAPHS (annular or pleural rings).—No special indication for treatment.
2. CAVITY IN EARLY TUBERCULOSIS.—Artificial pneumothorax. Cavity may heal under general treatment. Thoracoplasty not immediately indicated.
3. OPEN CAVITY CONTAINING PUS.—Artificial pneumothorax ; if prevented by adhesions, thoracoplasty ; collapse is essential.

For hæmoptysis, pneumothorax, laryngitis, and other complications, *see under* respective systems.

IV. TUBERCULOSIS OF THE LYMPHATIC GLANDS.

(*Scrofula. Tuberculous Adenitis.*)

Etiology.—

AGE.—Most common in children, but no age immune.

PREDISPOSING FACTORS.—Catarrh of mucous membranes

(a) Enlarged tonsils, adenoids, carious teeth (adults), for cervical glands; (b) Whooping-cough, measles, for bronchial glands.

Two physical types formerly emphasized: (1) Tall, slight, intelligent, with clear skin; (2) Thick-set, coarse and dull.

Site.—*Cervical glands* most common, often no other lesion: especially from three to ten years: in infancy, often deeper glands and more widespread.

Morbid Anatomy.—Ordinary changes of tuberculosis modified by histology of glands (*see* HISTOLOGY OF TUBERCULOSIS, p. 135).

Tubercles commence in cortex: gland enlarges: on section gray tubercles visible. If very early may be none visible, but microscopically foci of epithelioid cells and leucocytes. *Tubercles increase*, distinction between medulla and cortex lost, and usual changes follow, viz.: (1) Fibrosis. (2) Caseation. (3) Calcification. Often proceeding simultaneously. Gland on section in such stages is pale and homogeneous with caseous areas, gritty in places, and with capsule thickened. Also (4) Softening: common in superficial glands, producing 'cold abscess'. Peradenitis common, *adherence to other glands and structures*. Thus termination may be: (i) Calcification, especially deep glands; (ii) Dry caseous mass with fibrous capsule; (iii) Softening and rupture.

SPLEEN may be enlarged.

Noticeable Features.—In tuberculous adenitis: (i) Local character, often confined to one series of glands, e.g., cervical; (ii) Spontaneous healing common, e.g., calcified mesenteric glands; (iii) Frequent suppuration, especially in cervical glands; (iv) Glands may be long quiescent, and then cause acute miliary tuberculosis owing to adhesion to, and infection of, blood-vessels, and subsequent spread of tuberculosis through the blood.

Local Tuberculous Adenitis.—Of palpable glands, cervical group is most common seat, then axillary; glands of groin rarely.

CERVICAL.—Especially glands in posterior cervical triangle: commencing in glands at level of jaw, spreading down neck (superficially and deeply), then glands above clavicle, and axillary glands. Submaxillary glands common. Usually larger on one side than the other.

SYMPTOMS.—Anæmia, slight pyrexia if progress rapid.

PHYSICAL SIGNS.—In early stages, glands discrete; later form an adherent mass from peradenitis: subsequently adherent to skin, and finally soften and rupture if untreated.

Note.—Palpate cervical glands from behind.

PROGRESS.—Slow, often persist many years. Death rare.

MEDIASTINAL.—Common site, bifurcation of trachea, on right side.

SYMPTOMS.—*Cough*, paroxysmal and brassy (not unlike whooping-cough). Also wasting, anorexia, slight fever.

PHYSICAL SIGNS.—Absent or indefinite unless large mass. May be: (i) Dullness over manubrium sterni; (ii) Distended veins in neck; (iii) Venous hum over clavicle, *audible only on retracting head* (ascribed to pressure on veins); (iv) Signs of pressure on bronchi. May produce epituberculosis.

RADIOGRAPH.—Shadow may be distinct.

PROGRESS AND SEQUELÆ.—(i) *Healed calcified glands* or quiescent encapsulated caseous glands are common post mortem. (ii) *Acute miliary tuberculosis*: through adhesion and discharge into vessels. (iii) *Infection of the lung or pleura*: i.e., pulmonary tuberculosis. Hilum or base of the lung may be affected earliest: usually in children. Rare are: (iv) Pressure on vessels or nerves (recurrent laryngeal). (v) Perforation into bronchi, trachea, œsophagus.

TABES MESENTERICA.—Mesenteric and retroperitoneal glands affected. Mostly in childhood. Often primary, but may be associated with tuberculous peritonitis, either as cause or effect.

SYMPTOMS.—Wasting and debility. Puny limbs. Diarrhœa rarely absent. Fever moderate. Abdomen distended and hyper-resonant. Glands may form large mass, usually to right of umbilicus, but palpation often difficult owing to distension. Occasionally fatty stools from pressure on lymphatics. Glands very rarely suppurate and rupture. Calcified quiescent caseous glands frequent at autopsies.

Generalized Tuberculous Adenitis.—Not common. Widespread tuberculosis of lymphatic glands: other tissues little or no affection. Deep glands most involved, retroperitoneal, mesenteric, and bronchial, but superficial groups may also be affected. May be great enlargement. Spleen may be palpable. Temperature high but irregular. Constitutional symptoms severe but often indefinite. Polynuclear leucocytosis may be marked. Death from cachexia or, in children, not uncommonly tuberculous meningitis.

Diagnosis of Tuberculous Glands.—In children usually simple, in adults often difficult. Diagnosis from:—

HODGKIN'S DISEASE.—Chief diagnostic difficulty: important owing to prognosis. Note: (1) Glands remain discrete: in late stages may be some adhesions from periadenitis, but never adherent to skin and never soften. (2) Spleen usually palpable. Definite diagnosis impossible without microscopic section of gland.

PYOGENIC ADENITIS.—Secondary to septic focus on scalp, etc.

GLANDULAR FEVER.—Enlargement transient. Lymphocytosis.

SYPHILIS.—Enlargement general and usually slight: subsides with antisyphilitic treatment. Wassermann reaction positive. Other signs of syphilis.

Tuberculosis of the Lymphatic Glands—Diagnosis, *continued*.

SECONDARY MALIGNANT DEPOSITS.—Primary growth elsewhere. Microscopic section.

BLOOD DISEASES.—Examination of blood.

LYMPHOSARCOMA.—Rapid growth and early adhesions.

Rare are—

CYSTIC HYGROMA.—Congenital. } Fluctuation. No surrounding
BRANCHIAL CYSTS.—Position. } glands.

Blood Changes.—Leucopenia with relative lymphocytosis, similar to Hodgkin's disease. In generalized form, polynuclear leucocytosis, both in absolute numbers and relative percentage.

Spleen.—Occasionally but not usually palpable. (In Hodgkin's disease enlarged in over 70 per cent.)

Treatment.—

REST IN BED.—Absolute if any pyrexia: especially with deep glands.

EARLY STAGE, GLANDS DISCRETE :—

1. **REMOVE LOCAL INFECTION**.—Teeth, tonsils, and adenoids.

2. **GENERAL TREATMENT**.—Sea air, especially Margate or a voyage. Tonics, cod-liver oil.

GLANDS SOFTENING OR INCREASING after three to six months' treatment.—Aspirate: operation may be necessary later.

X RAYS.—*Have undoubted therapeutic effect, but need care.*

TUBERCULIN.—Now abandoned.

V. TUBERCULOSIS OF THE PERITONEUM.

(*Tuberculous Peritonitis*.)

Etiology.—

AGE.—Specially in young children: frequent up to 20 years: then becomes progressively less frequent, but occurs at all ages.

SEX.—In adults, commoner in women than men owing to infection from Fallopian tubes.

MODE OF ORIGIN.—

1. No cause found, i.e., *primary* tuberculous peritonitis. Rare, especially in adults. Tubercle bacilli of bovine type in 50–80 per cent, hence milk accepted as origin, bacilli passing through mucous membrane without causing lesion.

2. Tuberculous mesenteric glands present: disseminate bacilli.

3. From Fallopian tubes: common cause in women.

4. Pulmonary tuberculosis: sputum swallowed; rare.

Occasional origins and associations.—

5. Pleura (and rarely pericardium) may be also affected: constituting polyorrrhomenitis.

6. Primary tuberculosis of intestine.

7. Occasionally from the vesiculæ seminales. Not uncommon with ovarian tumours.

Morbid Anatomy.—Gray tubercles may be present on the peritoneum in acute miliary tuberculosis, pulmonary and generalized, also in chronic pulmonary tuberculosis, and on peritoneal surface of tuberculous ulcers of the intestine. In the more widespread disease clinically constituting 'tuberculous peritonitis', the following tissues may be concerned :—

PERITONEUM.—May be : (i) Tuberculous masses in peritoneum, often caseating : *the omentum is frequently involved.* (ii) Peritoneal adhesions between coils due to fibrosis. (iii) Diffuse peritonitis : tubercles scattered over peritoneum : specially associated with ascites.

MESENTERIC GLANDS.—As in *tabes mesenterica.* (See p. 165.)

INTESTINAL MUCOUS MEMBRANE.—Often but not always tuberculous : affects symptoms but not physical signs.

Results of Lesions.—The changes just mentioned may exist and coexist to varying extents ; and depending upon this are the following common results :—

1. **PRESENCE OF AN ABDOMINAL TUMOUR.**—May be :—
 - i. **OMENTUM.**—Tuberculous and 'rolled up' : palpable, lying across abdomen, near umbilicus : common.
 - ii. **SACculated EXUDATION.**—Due to combination of effusion and adhesions between coils ; position usually central, and may simulate ovarian tumour.
 - iii. **ENLARGED GLANDS.**—May form large masses.
 - iv. **INTESTINAL COILS.**—Thickened. Rarely palpable.
 - v. **FÆCAL ACCUMULATIONS.**—Extremely common, from intestinal obstruction and interference with peristalsis. Removed by enema.

Failure to feel masses subsequently found at operation may be due specially to (a) Ascites, (b) Tympanites.

2. **ASCITES.**—Specially with diffuse peritonitis : also affected by enlarged glands in hilus of liver.
3. **ADHESIONS BETWEEN COILS** from fibrosis.—May be extreme : tuberculous ulceration of intestine may lead to perforation into another adherent coil, or to formation of localized abscess.
4. **FISTULÆ.**—May form from extension and caseation of tuberculous masses : *usually at umbilicus ; may be fæcal* if also ulceration and adhesions of intestine.
5. **TYMPANITES.**—Due to : (i) Peritoneal adhesions in chronic cases ; (ii) Loss of tone in acute cases.

Clinical Groups.—Two types : (a) Ascitic ; (b) Plastic. Intermediate forms common.

a. **ASCITIC TYPE.**—Characterized by large amount of fluid.

b. **PLASTIC TYPE.**—Commonest. Amount of fluid small. Tumours and irregular masses common. Two groups :—

1. **ULCERATIVE OR CASEOUS.**—Tuberculous masses in peritoneum : caseation may result in abscesses and fæcal fistulæ : some fibrosis and matting of intestines.
2. **FIBROUS.**—Adhesions between coils marked : little fluid. Very chronic intestinal obstruction may result. For

Tuberculosis of the Peritoneum—Clinical Groups, *continued*.

extreme forms, *see* CHRONIC PROLIFERATIVE PERITONITIS and HYPERPLASTIC TUBERCULOSIS OF THE ILEOCÆCAL REGION.

TABES MESENTERICA.—Masses of tuberculous glands. Other changes slight. (*See* p. 165.)

Symptoms.—

MODES OF ONSET.—(1) *Rapid*, i.e., acute tuberculous peritonitis: In ascitic form: abdomen may fill in three days: pyrexia. (Probably rapid dissemination of bacilli.) (2) *Insidious*: In ulcerative form: common: gradual malaise for months. (3) *Obscure and chronic*: Fibrous form.

SYMPTOMS.—

SLIGHT GENERAL DISTURBANCE.—Weakness, loss of weight, pallor.

FEVER.—Variable. In commoner chronic cases slight, about 100°, either continuous or at intervals: frequently sub-normal. In acute form often 103° to 104°.

GASTRO-INTESTINAL SYMPTOMS.—Usually no vomiting or nausea. Constipation, if no ulceration of intestine. Diarrhoea, if intestine ulcerated: generally only looseness: may be offensive stools.

PAIN.—Usually slight: may be paroxysms due to obstruction. Tenderness on pressure.

PIGMENTATION.—Abdominal, or even general, pigmentation not uncommon. Buccal mucous membrane is unaffected (*cf.* ADDISON'S DISEASE).

Physical Signs.—Vary with type: intermediate forms frequent.

ASCITIC TYPE.—*Abdomen greatly distended*, shifting dullness in the flanks. Adhesions may cause sacculated exudations in more chronic cases.

PLASTIC TYPE.—(i) Ulcerative form: common variety: abdomen moderately distended, with characteristic doughy feel: no visible peristalsis: may be no other signs, but commonly *indefinite masses*, from omentum, glands, or tuberculous matter between coils. (ii) Fibrous form: ill-defined, may be palpable tumour, irregular coils, rolled-up omentum, or fæcal accumulations. (iii) Palpable tuberculous glands (*tabes mesenterica*): tumour central or near cæcum, usually fixed, outline irregular, hard.

Liver and spleen may be palpable.

Course.—In unfavourable cases, progressive wasting with increasing abdominal signs.

Complications.—*See* RESULTS OF LESIONS, *above*. *Anæmia*, rarely megalocytic and resistant to all treatment, may develop in extreme ulcerative forms.

Prognosis.—*Good*, generally, in plastic type and also in ascitic type if fluid diminishes with rest. *Bad*: (1) Under 2 years: tuberculosis nearly always becoming generalized. (2) With tuberculous enteritis. (3) After formation of fæcal fistulæ. (4) Tuberculosis elsewhere.

Diagnosis.—

IN CHILDREN.—Difficult in early stages: suggested by: (1) Loss of weight, or failure to gain properly; (2) Occasional pyrexia; (3) Bowels varying between constipation and diarrhoea. Later: diagnosis easy. Ascites rarely due to other cause.

IN ADULTS.—Often difficult. Diagnosis from:—

OVARIAN TUMOUR.—No fever, no shifting dullness, outline definite, tumour usually central, no disease in lungs, pleura, or Fallopian tube.

CIRRHOSIS OF LIVER.—History and appearance of patient; cytology of fluid on paracentesis if shifting dullness; edge of liver may be palpable.

MILIARY CANCER WITH ASCITES.—Cytology of fluid.

ACUTE FORM.—From pneumococcal peritonitis and appendicitis

PERITONEAL FLUID.—Lymphocytes (*see* PLEURAL FLUIDS).

Treatment.—

GENERAL.—*Complete rest* in bed until afebrile and symptoms and physical signs are subsiding. Many weeks or months. Fresh air.

DIET.—Full diet with fat. In diarrhoeal cases, milk diet.

LIGHT TREATMENT.—Applications to abdomen.

TONICS.—Cod-liver oil. If anæmia, syrup of the iodide of iron.

DIARRHOEA.—Check with Dover's powder, or with bismuth or chalk with tr. opii. Modify diet.

ASCITES.—If extreme, paracentesis, repeated if necessary. Laparotomy of doubtful value, but occasional improvement (not in plastic type).

Mercury ointment of doubtful value.

VI. TUBERCULOSIS OF THE ALIMENTARY CANAL.

LIPS.—Very rare. Occasionally ulcers from infection by sputum.

TONGUE.—Occasionally ulcers present in later stages of phthisis. Tuberculous sputum may infect crack and ulcer form.

CHARACTER OF ULCER.—On dorsum or edge: usually small: irregular edge and gray floor: may be multiple: extremely painful.

DIAGNOSIS.—Tuberculosis of lungs or larynx present. Diagnosis from: (1) Syphilis: Wassermann reaction. (2) Cancer: excise portion and examine.

TREATMENT.—Paint with cocaine before meals.

SALIVARY GLANDS.—*See* DISEASES OF THE SALIVARY GLANDS.

PALATE.—Only by direct extension.

TONSILS.—Groups: (1) Tuberculous ulceration. Rare. Infection from sputum. Never primary. (2) Enlarged tonsils: microscopically, tubercles found. (3) No macroscopic or microscopic tubercle, but inoculation produces tuberculosis in animals. Frequency still doubtful.

Tuberculosis of the Alimentary Canal, *continued*.

PHARYNX.—By extension from the larynx (*see* TUBERCULOUS LARYNGITIS).

ŒSOPHAGUS.—Of doubtful occurrence.

STOMACH.—Of doubtful occurrence. Immunity ascribed to acidity of contents.

FISTULA IN ANO.—Common in phthisis.

VII. TUBERCULOSIS OF THE INTESTINES.

(*Tuberculous Enteritis and Colitis*.)

Groups.—(1) *Primary*; (2) *Secondary to phthisis*; (3) *Secondary to tuberculous peritonitis*. A special type is *hyperplastic tuberculosis of the ileocaecal region*.

Morbid Anatomy.—

SITE.—Ileum, caecum, and colon. Most commonly at end of ileum. Commences in Peyer's patches and solitary follicles. Lymphoid tissue undergoes tuberculous changes, swelling, caseation, softening, and ulceration.

CHARACTER OF TUBERCULOUS ULCER.—(i) *Shape*: spreads *transversely round gut* by lymphatics and blood-vessels; may encircle it. (ii) *Walls and edges*: thickened and raised but not undermined (contrasting with typhoid ulcer). (iii) *Floor*: caseous, often shows miliary tubercles; (iv) *Peritoneal surface*: thickened, and miliary tubercles present. All layers are involved. Ulcers may be multiple.

Primary Intestinal Tuberculosis.—Extremely rare except in children. Infection by milk; bovine bacilli in 80 per cent.

Symptoms: (i) Irregular bowels, diarrhoea or constipation; (ii) Pyrexia; (iii) Pains; (iv) Wasting. Recurrent attacks may occur, closely simulating appendicitis.

Rarely diagnosed until sequelæ appear, or with tuberculosis in lungs or meninges.

Secondary Intestinal Tuberculosis.—Due to swallowing sputum. Present in 50 to 70 per cent of autopsies in phthisis.

Sequelæ.—(i) *Perforation and peritonitis*: uncommon owing to thickening of peritoneum and formation of adhesions. (ii) *Localized abscess formation*: following perforation. (iii) *Stenosis of intestine*: may result from fibrosis and cicatrization of healing ulcer: in small intestine with fluid contents obstruction may be slight. (iv) Tuberculosis of mesenteric glands and peritoneum: common in primary type. (v) *Hæmorrhage*: very rarely serious, but is occasionally fatal.

Symptoms.—

PRIMARY TYPE.—In children. Fever, irregular bowels, wasting: may be palpable glands.

SECONDARY TYPE.—Diarrhoea in course of phthisis, but this may also be due to catarrh or lardaceous disease.

Tubercle bacilli are present in stools in both forms.

Treatment.—See DIARRHOEA IN PULMONARY TUBERCULOSIS (p. 163).

Hyperplastic Tuberculosis of the Ileocaecal Region (*Tuberculous Caecal Tumour*).—Uncommon but important condition. Great thickening of the muscular and subserous coats: walls may be one inch thick: lumen greatly diminished. In rare cases may affect sigmoid or small intestine.

PATHOGENESIS.—The condition may be allied to Crohn's disease, merges into CHRONIC PROLIFERATIVE PERITONITIS (q.v.), and the tuberculous origin of the group is uncertain.

TYPES.—(1) Definite tumour in right iliac fossa, 'tuberculous caecal tumour': usually vertical, hard, fixed, and tender. (2) General thickening in right iliac fossa but no definite tumour: as in recurrent appendicitis. Faecal fistula may form.

SYMPTOMS.—Attacks of pain in right iliac fossa, irregular diarrhoea and constipation, pyrexia, and wasting.

DIAGNOSIS.—From:—

CANCER.—Difficult even at operation. Duration longer than in cancer, usually two or three years, but may be longer: age generally under forty years.

APPENDICITIS.—Second type especially simulates appendicitis: diagnosis before operation may be impossible: accounts for certain cases of obstinate faecal fistulae seen after appendix operations. *Tubercle bacilli* may be present in discharge or even in stools.

DIVERTICULITIS.

TREATMENT.—Operation, lateral anastomosis, and removal of tumour if possible: complete removal of all tissue is not essential.

VIII. TUBERCULOSIS OF THE LIVER.

Rare. Occurs in various forms:—

1. **MILIARY TUBERCULOSIS.**—Common in acute miliary tuberculosis. Tubercles in capsule and tissue: usually scanty and very minute, especially in tissue.
2. **SOLITARY TUBERCLE.**—Tuberculous mass. Very rare.
3. **TUBERCULOUS PERIHEPATITIS AND CIRRHOSIS.**—Occurs with chronic proliferative peritonitis. No absolute proof of tuberculous origin.
4. **TUBERCULOSIS OF GALL-BLADDER AND BILE-DUCTS.**—Very rare. Occasionally recorded with gall-stones.

IX. TUBERCULOSIS OF THE PLEURA.

Very common. May be:—

1. **PRIMARY.**—No history or evidence of previous pulmonary or glandular tuberculosis. But probably present.

Tuberculosis of the Pleura, *continued*.

2. SECONDARY.—Evidence of previous pulmonary tuberculous disease. May occur without obvious cause, or after artificial pneumothorax, or attack of coughing rupturing a focus in the lung.

TYPES OF PLEURISY.—

a. DRY PLEURISY.

b. CHRONIC ADHESIVE PLEURISY.—Associated with fibroid lung.

c. PLEURISY WITH EFFUSION.

Pleurisy with Effusion.—

1. EFFUSION SEROUS (or rarely hæmorrhagic).—For physical signs and treatment, *see* section on DISEASES OF THE RESPIRATORY SYSTEM.

2. EFFUSION SERO-PURULENT OR PURULENT (*tuberculous empyema*).—

TREATMENT.—(1) Aspirate and replace fluid removed with air; (2) Lavage; (3) Thoracoplasty later.

PROGNOSIS.—Serious, especially occurring with pneumothorax.

3. EFFUSION PURULENT WITH MIXED INFECTION (*tuberculous empyema*).—

ORGANISMS. — Streptococcus, staphylococcus, anaerobic.

With gross pulmonary disease and often bronchial fistula.

TREATMENT.—Resection of rib, drainage. Thoracoplasty later.

PROGNOSIS.—Serious.

X. TUBERCULOSIS OF THE BRAIN.

Occurs as: (1) *Acute miliary tuberculosis*, viz., tuberculous meningitis; (2) *Solitary tubercle*: produces symptoms of cerebral tumour: the meninges are usually affected to some degree. (*See* INTRACRANIAL TUMOURS.)

Section I.—Specific Infectious Diseases, *continued*.

B. NON-BACTERIAL FUNGUS INFECTIONS.

CHAPTER XXI.

ACTINOMYCOSIS. MADURA DISEASE.

ACTINOMYCOSIS.

Chronic granulomatous lesions, tending to suppurate, produced by the *Streptothrix actinomyces*, or 'ray fungus'.

Occurrence in Nature.—Occurs mainly in cattle, horses, and man: occasionally in pigs. Summary of main differences between cattle and man: (1) *Cattle*.—Especially affects jaw and tongue, causing large, hard swellings ('woody tongue', 'big jaw'); very chronic, formation of much granulation and fibrous tissue. Clubs numerous and Gram-positive, filaments less definite. (2) *Man*.—More rapid, greater tendency to suppuration and less to granulation-tissue formation; swellings smaller and less hard; microscopically, clubs fewer or absent and Gram-negative, filaments numerous.

The following paragraphs refer to occurrence in MAN, except where specially noted.

The Parasite.—A streptothrix, characterized by true branching (hence not bacterial): probably allied to *B. tuberculosis*.

MORPHOLOGY.—Pleomorphous. Three elements present in tissues:—

FILAMENTS.—Thin: length indefinite: *true branching*. Gram-positive. In old colonies often dense and irregular staining.

SPORES OR GONIDIA.—Gram-positive. Coccic forms: can reproduce filaments.

CLUBS.—Hyaline swelling of extremity of a filament, producing structureless, pear-shaped body: may form a ring at edge of colony: probably defensive against phagocytes. In man, often absent, often Gram-negative. (In cattle, numerous and Gram-positive.)

CHARACTER OF PUS.—From an abscess pus is thin, greenish-yellow, *containing small clumps, size of a pin's-head*, visible to the naked eye, usually yellow, and formed of the streptothrix. (Old pus may be thicker.)

Examination of Pus.—Pick out clump and place on microscope glass: tease or squeeze clumps flat between cover-slips, stain with Gram or carbol-thionin. Branching filaments easily recognized.

Actinomycosis—The Parasite, *continued*.

CULTIVATION.—Difficult. *Anaerobe*. (J. H. Wright and others.)

MODE OF INFECTION.—Formerly supposed to be present on grain, especially barley. Proof of anaerobic nature now renders this doubtful. Probably direct infection from animals. Still under discussion.

Changes produced in Tissues.—Chronic inflammatory reaction, little granulation tissue: spreading suppuration: mainly filamentous forms. In dense tissues more granulation; in soft tissue, e.g., liver, more pus formation.

Clinical Characteristics.—Usually in males, commonly connected with cattle. Three chief sites, possibly corresponding to paths of infection:—

1. **JAW AND NECK**.—*Chronic* unilateral swelling of jaw and neck; later superficial abscesses on skin, which discharge pus. Mode of infection: probably through carious tooth or tonsil. Forms 50 per cent of cases.
2. **INTESTINAL**.—Especially *appendix*, also cæcum and large intestine. Great tendency to spread in various directions: to peritoneum, forming abscesses between coils; to abdominal wall, causing superficial œdema and abscesses; to retroperitoneal, retrocæcal, and perirectal tissues. Occasionally in œsophagus. Infection: probably with food.

SYMPTOMS.—Depend on site: septic phenomena, chronic appendicitis, often indefinite nature. Includes about 20 per cent of cases.

3. **PULMONARY**.—Various types of chronic pulmonary disease: (a) Chronic bronchitis; (b) Resembling miliary tuberculosis; (c) Bronchiectasis, fibrosis, foetid bronchitis. Great tendency to involve pleura, ribs, sternum, and thoracic wall, forming abscesses. Infection: respiratory, or possibly from neck, œsophagus, or abdomen.

SYMPTOMS.—Irregular pyrexia, cough, wasting, sputum which may contain streptothrix. Physical signs often unilateral.

METASTASES and formation of secondary abscesses occur in many directions, possibly by leucocytes engulfing filaments. Of importance are:—

LIVER.—Not uncommon: characteristic 'honey-comb' appearance, containing pus.

CEREBRAL ABSCESS (in head cases).

Skin infections have been recorded. Also kidneys, etc.

Diagnosis.—Depends on identification in pus, tissues, or sputum of the causal streptothrix, viz., branching filaments or clubs. Agglutination test of value. Suggestive: (1) Association with cattle and horses; (2) Chronic pyæmia; (3) Character of pus: fairly clear with *pin-head masses*.

Prognosis.—Depends on extent of spread and on site: (1) Jaw and neck: recovery usual. (2) Intestinal: prognosis fair. (3) Pulmonary: fatal. Always prolonged. Tendency to recurrence after apparent cure: but rare after two years' freedom.

Treatment.—Combined surgical and medical:—

SURGICAL.—Treat on general principles: usually impossible to remove focus entirely.

MEDICAL.—Potassium iodide in maximum doses (gr. xl to lx daily) for many months.

X rays in superficial forms.

Variations.

Aerobes.—Certain strains isolated from human cases have been aerobic: in general less serious than anaerobes, and recovery may occur from pulmonary infections.

Actinobacillus.—A small Gram-negative aerobic bacillus has been isolated from cattle in conditions resembling actinomycosis but in which no filaments were present.

MADURA DISEASE.

(*Madura Foot. Mycetoma.*)

A chronic granuloma, practically confined to the foot, and characterized by great enlargement, formation of cavities, and discharge of granules. Due to infection with various fungi. Very prevalent in India and other parts of the tropics. *Foot* almost invariable site of affection. Rarely hand.

Clinical Description.—Extremely chronic: progress very slow.

INCUBATION PERIOD.—Experimentally, 10 to 16 days.

ONSET.—Swelling on foot: irregular nodular character: slowly softens in centre: discharges *granules*.

PROGRESS.—Great enlargement of foot: numerous sinuses and cavities: caries of bone. Gradually destroys all tissues. No tendency to heal or to become cured. Death from exhaustion after many years. Internal lesions never occur (unless terminally).

CHARACTER OF GRANULES.—Granules are present in cavities: larger than in actinomycosis: collections form definite nodules. Two varieties occur:—

1. *Pale.*—Is a streptothrix: morphologically resembles actinomycosis, but is distinct, aerobic, does not liquefy gelatin, no effect on animals.
2. *Black.*—Is a hyphomycete (J. H. Wright).

Treatment.—Excision or amputation. Potassium iodide valueless. X rays: good results recorded.

Section I.—Specific Infectious Diseases, *continued*.

C. PROTOZOAN INFECTIONS.

CHAPTER XXII.

MALARIAL FEVER.

Conditions due to infection with certain specific protozoa conveyed by bite of mosquitoes, and characterized by fever, often periodic and controlled by quinine; occasionally by malignant fatal forms; and by a chronic anæmia and enlargement of the spleen.

Geographical Distribution.—Almost universal where warmth and water exist together. Animals are not infected.

THE PARASITE.

Four definite species exist in man: (1) Benign tertian—*Plasmodium vivax*; (2) Ovale tertian—*P. ovale*; (3) Quartan—*P. malariae*; (4) Malignant tertian or subtertian—*P. falciparum*.

The life cycle has two stages: (1) *Intracorpuseular*. Asexual. Recurrent cycles in human body. Man is the intermediate host. (2) *Extracorpuseular*. Sexual. Single cycle in the mosquito, which acts as the definitive host.

1. Cycle in Human Body.—Intracorpuseular and asexual.

The principal characteristics are: (a) Recurrent asexual cycles which take place in the red corpuscles; (b) The production of sexual cells, of which the further development only takes place in the mosquito.

Cycle is commenced by entry of protozoon into red cells. Chief stages in cycle and growth of protozoon are:—

1. THE PROTOZOON may enter the red cells either as:—

SPOROZOITE.—Introduced by mosquito bite, adheres to and penetrates a red cell (primary infection). Or:

MEROZOITE.—Spore produced in human cycle penetrates red cell (recurrent cycle).

2. TROPHOZOITE.—Growth of amœbulæ within red cells. Protozoon grows in size, exhibits amœboid movement, pigment appears as granules and increases in amount, forming from hæmoglobin.

MORPHOLOGY (Leishman and other Romanowsky stains).—

i. Shape very variable: in earlier stages often 'ring forms'.

ii. Protoplasm stains blue.

iii. Intense red chromatin in nucleus.

iv. Dark pigment (hæmozoin).

'Full-grown parasite': no amœboid movement: roughly round.

3. SCHIZONTS.—*Stage of sporulation.* Protoplasm divides into segments, into which the red chromatin scatters: pigment collects in centre. Red cell ruptures, dispersing the spores or so-called 'merozoites': pigment enters leucocytes.
4. MEROZOITES (spores).—Round: about $2\ \mu$: protoplasm stains blue: red chromatin in nucleus. Spore attaches to and enters red cell, and a fresh cycle commences.

GAMETOCYTES.—Sexual cells.

Certain trophozoites become sexual cells, developing no further in man. Two forms: (a) Macrogametocytes: female cells. (b) Microgametocytes: male cells; smaller.

Varieties of Parasite.—Main differences in human stage:—

1. BENIGN TERTIAN.—*Plasmodium vivax.*

Cycle: forty-eight hours.

Trophozoite: 'ring' forms of various sizes. Growing forms irregular. Active amoeboid movements. Hæmozoin: fine, light brown granules. Outline indistinct.

Red cells: enlarged, pale, may be basophilic degeneration.

Schüffner's dots: often present in red cell containing protozoon in middle stages: stain pinkish.

Pigment: fine, light brown granules.

In fresh blood: active amoeboid movements in earlier stages. Outline indistinct.

Schizont: 'rosettes', 15 to 20 regularly arranged spores.

Gametocyte: resemble large round or ovoid fully-grown parasites. Females larger than males, stain deeper, pigment coarser, central nucleus. Larger than red cells.

2. OVALE TERTIAN.—*Plasmodium ovale.*

Cycle: forty-eight hours. Resembles *P. malariae*, but gametocytes oval.

3. QUARTAN.—*Plasmodium malariae.*

Cycle: seventy-two hours.

Trophozoite: as benign tertian, but movement slight, outline distinct, and pigment coarse, dark brown granules.

Red cells: unaltered in size and appearance. No Schüffner's dots.

Schizont: 'daisy-heads', 6 to 12 regularly arranged spores.

Gametocyte: as benign tertian, but smaller than red cell.

4. SUBTERTIAN (*Æstivo-autumnal*).—*P. falciparum.*

Main distinctions from previous forms are:—

1. Sporulation and great portion of cycle takes place almost entirely in internal organs, especially spleen. In peripheral blood, parasites scanty and are mainly sexual 'crescents' and asexual 'ring forms'.
2. Gametocytes are 'crescentic', not resembling the asexual forms. Only appear in blood after 7 to 10 days' fever. 'Crescents': distinct outline, pigment and chromatin in centre remains of red cell often visible. Male form is fatter, stains lighter, and has pigment more scattered than female.

Malarial Fever—The Parasite, continued.

Other differences:—

Cycle: uncertain. Probably forty-eight hours.

Trophozoite: chiefly as small 'rings'. Full-grown forms smaller than red cell. Actively amoeboid. Pigment: scanty dark granules.

Red cells: shrivelled and dark. No Schüffner's dots.

Maurer's dots: larger, less regular, stain violet.

Schizont (in spleen): 6 to 20 small irregularly arranged spores.

2. Cycle in Mosquito.—Extracorporeal and sexual.

Cycle commences from *gametocytes* taken into stomach of feeding mosquito: asexual forms from human blood take no part. (The earlier stages will occur in a drop on a microscope slide.)

1. DEVELOPMENT OF GAMETOCYTES.—

Male cell: vibratile movements of pigment granules become visible, then flagella are extruded forming 'flagellated body'. The 'flagella' are long, thin, often with a bulbous end, and have a deep red chromatin core covered with protoplasm; they are spermatozoa, 'microgametes', and not true flagella.

Female cell: maturation occurs by separation of portion of nucleus, resulting in a 'macrogamete'.

In subtertian type, first stage is conversion of crescent into a sphere.

2. IMPREGNATION OF FEMALE MACROGAMETE.—'Flagella' become free, enter and impregnate female gametes. The resulting cell has power of movement, the 'travelling vermicle' or *zygote*.**3. PENETRATION OF STOMACH WALL.—**The 'oöcyst'. The zygote penetrates the mucous membrane, settles beneath it, acquires a definite wall or sporocyst, and thus forms the 'oöcyst'.**4. FORMATION OF SPOROZOITES.—**The 'oöcyst' grows by division into numerous cells (sporoblasts), and these further divide, until finally the oöcyst, now 60 μ in diameter, is full of fine spindle-shaped 'sporozoites', staining blue, with central chromatin nucleus. It ruptures, and the sporozoites reach the salivary glands of the mosquito, and thence, on biting, pass into human body, causing infection and commencing human asexual cycle.

Duration of cycle.—For subtertian variety twelve days. For others, seven to ten days. Mosquito in interval is not infective.

The Mosquito.—Genus *Anopheles* is sole host of malarial parasite: numerous species exist, in America and Europe especially *A. maculipennis*. *Culex*, the common mosquito in houses, breeds in tanks, etc., near dwellings: when resting, one pair of legs is elevated above body, a definite distinction from *Anopheles*. *Anopheles* breeds in sluggish streams and small pools: activity is confined to night.

NOTE.—Female mosquitoes only are blood-suckers: males feed solely on vegetable juices. Range of flight is very limited, not exceeding one to two miles.

MORBID ANATOMY.

Mortality is due to pernicious forms, chronic cachexia, and rarely rupture of spleen: common acute malaria is not fatal.

- **PERNICIOUS FORMS** (nearly always *P. falciparum*).—*Spleen* moderately enlarged and very soft. *Pigment* present in spleen, liver, brain, bone-marrow. Capillaries in all sites contain parasites and pigment; may be completely obstructed.

In cerebral type, numerous parasites in small cerebral vessels, and in algid type, in intestinal vessels.

MALARIAL CACHEXIA.—(1) *Anæmia* severe; (2) *Spleen*, very large—5 to 10 pounds; (3) *Liver* usually enlarged; (4) *Pigment* in large amounts in spleen, liver, kidneys, and intestines, causing a slaty appearance. Definite nephritis and cirrhosis of liver may be present.

The Blood.—

- A. ACUTE FORMS OF MALARIA**.—(1) *Malarial parasites*. (2) *Red cells*: number reduced. Earlier paroxysms may cause large reduction, but effect of individual paroxysm becomes less on repetition. *Hæmoglobin* reduced in proportion to red cells. (3) *Leucocytes*: Leucopenia with relative lymphocytosis. Large mononuclears increased. (May be a leucocytosis during paroxysm.) (4) *Pigment*: Brown, yellowish, or black: in clumps or various shapes: free in blood or in phagocytic leucocytes. May contain or be free from iron. Schüffner's dots in red cells, only in tertian infections: altered hæmoglobin. Maurer's dots in subtertian infections: origin doubtful.
- B. MALARIAL CACHEXIA**.—Changes of a secondary anæmia. (1) *Red cells*: reduced, often 2,000,000 per c.mm. *Hæmoglobin* reduced and colour index low. (2) *Leucocytes*: Leucopenia with relative lymphocytosis. *Parasites* usually scanty, may need prolonged search. *Pigment* generally slight. Schüffner's dots may be present in red cells.

Pathogenesis.—Little understood. Febrile paroxysm coincides with sporulation and is ascribed to toxins set free. Anæmia results from destruction of red cells by parasite, the hæmoglobin being the origin of the pigment.

CLINICAL VARIETIES AND FEATURES.

Can be based upon: (A) Type of fever: (i) Regular, intermittent; (ii) Irregular, remittent; (iii) Continuous and pernicious forms. (B) Type of parasite. Both unsatisfactory: thus, malignant tertian occasionally produces regular paroxysms, and benign tertian and quartan may, though rarely, produce remittent and pernicious forms.

CLASSIFICATION.—Manifestations considered under following headings: (1) *Benign and ovale tertian fever*. (2) *Quartan fever*. (3) *Subtertian fever*: (a) Regular intermittent form; (b) Irregular

Malarial Fever—Malignant Tertian, continued.

(i) Unconscious twelve to twenty-four hours, then recovery :
 (ii) Frequently fatal ; (iii) Recovers consciousness, followed by a *second and fatal coma* ; common. (b) Hyperpyrexial type. Temperature during paroxysm continues to rise ; may be mania ; then coma and death. Often diagnosed as 'heat stroke'. (c) Sudden coma ; resembling apoplexy or epilepsy. Variable temperature, 101° to 103°. Usually previous malaria. Fatal in one to two days. Rare.

ii. ALGID FORM.—

'ADYNAMIC TYPE'.—*Extreme prostration and weakness.* Pulse feeble. Temperature often subnormal, or slight rise. Respiration rapid. Vomiting common. Feels cold. Urine diminished. *Death* frequent : may be conscious to end.

'CHOLERAIC TYPE'.—Similar, with extreme diarrhoea and vomiting. Parasites numerous in intestinal mucosa and vessels.

iii. 'BILIOUS REMITTENT FEVER'.—Predominant symptoms :

(1) Jaundice ; (2) Vomiting of bile-stained fluid. Epigastric pain, hiccup, and hæmatemesis and hæmorrhages common. Fatal if untreated.

RARE SEQUELÆ AND COMPLICATIONS.—

Peripheral neuritis.

Hemiplegia : May occur (a) in comatose form, (b) at height of ordinary paroxysm.

Amblyopia : In comatose form : usually transient.

Conditions of acute ataxia, or of disseminated sclerosis : very rarely.

4. Malarial Cachexia.

Occurs with chronic malaria. Characterized by : (1) Anæmia ; (2) Enlarged spleen.

SYMPTOMS.—(i) Skin of grayish hue ; (ii) Symptoms of secondary anæmia ; (iii) Spleen greatly enlarged ; (iv) Fever, occasional rises.

BLOOD.—Parasites scanty. See MORBID ANATOMY.

COURSE.—Amenable to prolonged treatment.

5. Course and Prognosis.

General Course.—Paroxysms are controlled rapidly by quinine and certain synthetic drugs.

Mortality.—In tertian and quartan infections : low ; fatalities may occur in debility with complications and chronic malaria. In subtertian infections : Mortality often high in pernicious forms and blackwater fever.

Relapses.—Frequent. With quinine and plasmoquine treatment about 20 per cent ; with atabrin said to be 10 per cent. Relapse often excited by chill, ill-health, operations, etc.

Latent Infection.—May be long interval without symptoms between relapses. Theories of latency include: (1) Small number of parasites persist, undergoing normal cycle, and increase suddenly—probable; (2) Sexual forms linger in spleen, etc., and suddenly sporulate—improbable.

Duration of Liability to Relapses.—In benign tertian: usually 1 year, or up to 4 years. Ovale: short period. Quartan: persistent, 6 years or longer. Subtertian: up to $1\frac{1}{2}$ years (Manson-Bahr). Malaria is a self-limited infection.

Immunity and Re-infections.—Natives acquire partial immunity after repeated infections in childhood. Re-infection otherwise occurs readily.

Complications.—Nephritis in quartan infections. Other diseases may coexist: e.g., enteric, pneumonia, dysentery.

6. Therapeutic Infections.

Value in treatment of dementia paralytica now established (see also DEMENTIA PARALYTICA). *Benign tertian* in general use: many fatal cerebral cases with subtertian.

Methods of Infection.—(1) Bites of infected *A. maculipennis*. (2) Inoculation of malarial infected blood: (a) Intravenous, 0.5 to 2 c.c.; (b) Subcutaneous, 2 to 4 c.c. Note: risk of syphilis.

Course of Fever in Therapeutic Infections.—*Incubation period*: 4 to 25 days. Paroxysms are of normal type: may be preceded by remittent fever. Termination: may cease spontaneously after eight or more paroxysms; may relapse. As routine, is terminated therapeutically after twelve paroxysms: (a) Infected by inoculation of blood: cure usually rapidly controlled by quinine; rapid and permanent by 3 to 10 gm.; relapses rare. (b) Infected by mosquitoes: many relapses on above dose, but cases are finally cured with few exceptions.

Infected persons are infectious in malarial districts: retain under observation until free from parasites for 3 weeks.

Information from Therapeutic Infections.—Among numerous important observations the following may be noted:—

1. *Incubation Period.*—Very variable in different persons with same infection. Inoculation of blood: (a) Intravenous, 4 to 8 days; (b) Subcutaneous, 6 to 25 days. Mosquito infections: 7 to 20 days.
2. Onset of malaria often commences with remittent fever for a week or more before paroxysms commence.
3. Infection from single mosquito may give quotidian paroxysms.
4. Virulence from same infection varies greatly in different persons.
5. *Tolerance.*—In 50 per cent, spontaneous cessation after 8 paroxysms: attempts at re-infection may fail. Initial infection never fails with infected mosquito, but may with inoculation, especially with previous malaria.
6. Pure gametocyte infections do not produce malaria.

Malarial Fever—Therapeutic Infections, *continued*.

7. Each type retains its own characters permanently.
8. *Quinine Prophylaxis*.—Quinine administered 5 days before and 7 days after infection does not prevent malaria, but if continued 10 days after infection is preventive.
Conclusion: Quinine has no effect on sporozoites introduced by mosquito or on trophozoites: effect commences at stage at which protozoon can begin to cause symptoms.

DIAGNOSIS.

DIAGNOSIS FROM:—

1. Other tropical fevers, e.g., kala-azar.
2. Enteric fever. Clinically may be impossible.
3. Tuberculosis, with hectic temperature.
4. Severe forms from: heat stroke; hæmorrhage; yellow fever.
5. Chronic forms from other causes of large spleen and anæmia.

METHODS OF DIAGNOSIS.—

1. Presence of malarial parasites.
2. Therapeutic test: *an intermittent fever* resisting quinine is not malaria.
3. Periodicity of fever (not conclusive). Enlarged spleen.

EXAMINATION OF BLOOD FOR PARASITES.—

(*Note*.—Examination most valuable shortly *before* a paroxysm is due, and not during height of attack, when sporulation has lately occurred, except for malignant forms. Quinine should be withheld in doubtful cases until blood has been taken, *unless urgent*.)

1. Fresh blood. A drop on a slide under a cover-slip ringed with vaseline. Needs experience.
2. Film of blood stained by a Romanowsky method.
3. Ross's thick film method. A drop on a slide: dried: red cells carefully hæmolyzed with distilled or tap water: dried, and stained by Romanowsky method. (Rapid and effective if parasites scanty.)

Species of Plasmodium.—Malignant tertian is proved by presence of 'crescents', and strongly suggested if 'ring forms' are numerous. (See also VARIETIES OF PARASITE, p. 177.)

BLOOD.—See MORBID ANATOMY.

TREATMENT.

Quinine is a true specific remedy. Most reliable method is by regular doses. Mode of action doubtful. (See THERAPEUTIC INFECTIONS *above*.) Action on gametes (sexual cells) none or very slight, but none develop if treatment is early.

Cinchona Alkaloids.—Other cinchona alkaloids are cheaper than quinine and can control malaria, e.g., 'cinchona febrifuge'; useful for treatment of large numbers of simple forms of malaria.

General Treatment.—Rest in bed. Much fluid. Light diet. Bowels open (calomel and salines).

COLD STAGE.—Hot blankets and warmth.

COLLAPSE.—Stimulants, brandy, etc.

HYPERPYREXIA.—Cold baths. Ice-water enema. Ice to head.

GREAT RESTLESSNESS, and in CHOLERAIC FORM.—Opium.

Quinine.—

PREPARATIONS.—Best are : (1) Bisulphate : cheap and effective.

(2) Bihydrochloride : very soluble and best for injections.

'Euquinine' (ethylcarbonate) is tasteless, and useful for children : similar dosage : some good authorities doubt its efficiency.

METHODS OF ADMINISTRATION.—

BY MOUTH.—Effective except in special circumstances. Administer in solution preferably, but most tablets are absorbed.

INTRAMUSCULAR INJECTIONS.—When vomiting prevents oral administration, and in resistant cases. *Absolute asepsis is essential* of skin, syringes, etc., owing to frequency otherwise of abscesses and tetanus. Dissolve quinine in absolute alcohol and add sterile water or saline (Mxx). Inject into gluteus maximus.

INTRAVENOUS INJECTIONS.—In urgent cases, especially cerebral and algid forms. Inject gr. xv in 10 to 20 c.c. normal saline. Risk of cardiac failure from rapid fall of blood-pressure : hence add adrenalin, also inject slowly, one to two minutes. Some danger.

OTHER METHODS.—Subcutaneous : absorption slight owing to formation of coagulum. Rectal injection : absorption slight.

TERTIAN AND QUARTAN PAROXYSMS.—*Dosage* : By mouth, gr. x t.d.s. for 4 to 7 days until fever ceases. Then gr. x twice a day for two weeks. Then gr. x once a day for two and a half months.

SUBTERTIAN PAROXYSMS.—*Dosage* : By mouth, as above. With severe forms, gr. x intramuscularly per diem until controlled ; then by mouth.

PERNICIOUS FORMS.—Intravenous injection : once usually effective ; repeat within few hours if necessary.

MALARIAL CACHEXIA.—Remove to non-malarious locality. Quinine, if parasites present. Good food, and fresh air. Arsenic, iron, and strychnine tonics.

INTOLERANCE.—For vomiting, alkalis or tr. iodi ; if it continues, give by injection. Hydrobromic acid of doubtful value.

PREGNANCY is not a contra-indication.

LATENT CASES.—Prolonged treatment with quinine.

Plasmoquine.—Specially effective in subtertian infections, 'crescents' disappearing in 4 or 5 days, against several weeks with quinine. Toxic symptoms include : cyanosis and intestinal disturbances, also methæmoglobinuria resembling mild blackwater

Malarial Fever—Treatment, continued.

fever; risk lessened by giving sugar. Used as plasmoquine-compound, containing 0.01 gm. plasmoquine and 0.125 gm. quinine. Dosage: 2 tablets daily by mouth for one week, then interval of 4 days: repeat for 4 or 5 courses.

Atebrin.—Yellow powder soluble in water. Urine becomes yellow. Acts on schizonts, not on gametocytes. Most effective in subtertian infections; relapses reduced. Toxic symptoms: yellow staining of skin (temporary); colic; dreams and cerebral excitement. Dosage: 1 tablet 0.10 gm. by mouth (swallow whole) t.d.s. on full stomach for 10 days. May be combined with quinine treatment. Expensive.

Atebrin musonate under trial for intramuscular injections; effective, but toxic (safety not yet confirmed).

Prophylaxis.—Malaria can be brought under control: accomplished by Ross in Ismailia, by Gorgas and others in Panama Canal zone and in Havana.

Prophylactic measures include:—

1. Breeding sites of mosquitoes destroyed by drainage, destruction of shallow pools, etc.
2. In large areas: kerosene poured on pools and shallow streams, and banks smeared with insecticide.
3. Destruction of *Anopheles* in houses.
4. Isolation of malarial patients and infected persons, to prevent infection of mosquitoes.
5. Prevention of mosquito bites: screened houses, mosquito nets over beds, Wellington boots, etc.

QUININE PROPHYLAXIS.—Persons entering a malarial district take 10 gr. daily. Does not prevent infection (*see* THERAPEUTIC INFECTIONS), but mitigates symptoms and reduces liability to blackwater fever.

Estimation of Prevalence or Endemic Index of a District.

Many individuals, especially native children, show few symptoms. Prevalence estimated by: (a) 'Parasite rate': percentage in whom parasites are present. (b) Ross's 'spleen rate': rapidly performed and is of sufficient accuracy.

CHAPTER XXIII.

BLACKWATER FEVER.

(*Malarial Hæmoglobinuria. Hæmoglobinuric Fever.*)

An acute condition produced by malarial infection, characterized by pyrexia, hæmoglobinuria, bilious vomiting, and jaundice, with rigors and frequently diminution or suppression of urine.

The immediate cause is great hæmolysis of red cells. All grades of malarial hæmoglobinuria are probably of similar origin, degree of

severity varying, the most extreme constituting blackwater fever as here described. The title 'blackwater fever' is retained as being in common use.

Relation to Malaria.—Occurs only in persons previously resident in endemic areas of subtertian malaria for at least six months and usually two or more years. Is result of repeated attacks of or continuous infection with subtertian malaria. (Benign tertian infection may also be present.)

PRESENCE OF MALARIAL PARASITES DURING ATTACK.—If examined before attack, parasites are nearly always present: rapid disappearance during attack watched on many occasions. Rarely present, or very scanty, after first twenty-four hours: due to dissolution of red cells which have contained and been damaged by plasmodia.

RELATION TO QUININE.—Attacks are almost invariably preceded by irregular administration of quinine insufficient to cure infection. Few authentic cases recorded without previous administration of quinine. May occur after atebirin.

Note.—Quinine without malaria can, though rarely, cause hæmoglobinuria, but not to extent or with symptoms of blackwater fever.

Theory of Pathogenesis.—Destruction of red cells is due to hæmolysin in blood: dissolution of red cells occurs in circulation, producing hæmoglobinæmia.

ORIGIN OF HÆMOLYSIN.—Destruction of red cells repeatedly occurs in recurrent attacks of malaria: disintegrated products of these red cells, altered by plasmodia, act like foreign blood, producing a hæmolysin as in a 'hæmolytic serum'.

Onset in Temperate Climates.—Attacks not infrequently occur on return to cooler climates: often within few days, not exceeding ten weeks (Manson-Bahr). Often follows large dose of quinine taken after an interval for recurrence of malaria or a chill.

Morbid Anatomy.—

SPLEEN.—Enlarged and soft. Active phagocytosis present.

LIVER.—Enlarged and soft. Often degenerated.

KIDNEYS.—Tubules contain débris and casts. Epithelium little altered.

Symptoms.—A chill, or dose of quinine, or both, may precipitate an attack.

PRODROMAL SYMPTOMS.—Often a slight attack of malaria treated with quinine. In others: more vague—general malaise, digestive disturbances, spleen painful, urobilin increased. May be none, until rigor and red urine passed.

ONSET.—Characteristic symptoms usually commence suddenly. Onset with rigors in 50 per cent: often recurrent, several hours.

HÆMOGLOBINURIA.—Urgent desire to micturate after a rigor; dark urine passed. Duration of dark urine few hours to one day; rarely exceeds two days.

Blackwater Fever—Symptoms, continued.

TEMPERATURE.— 103° to 105° : irregular. May be 100° or lower. Falls as urine clears.

BILIOUS VOMITING.—Much retching and epigastric pain.

ICTERUS.—Within 24 hours of onset: becomes intense.

GENERAL SYMPTOMS.—Restlessness. Pain in loins. Great thirst. Exhaustion. Liver and spleen enlarged and tender.

PROGRESS.—(a) *Recovery.* Urine clears, and temperature falls: sweats and then symptoms pass away. (b) Symptoms increase. Restlessness, rigors, high temperature. *Thirst extreme.* Hiccup serious. Urine diminished: final anuria common: fatal termination. Blood-urea raised.

DEATH from: (i) *Cardiac failure*—great exhaustion; (ii) *Anuria*; (iii) *Hyperpyrexia.* Coma or delirium common.

MORTALITY.—About 25 per cent.

Urine.—In early stages, amount increased and micturition frequent. On standing, separates into two layers: (i) Clear and dark. Gives spectroscopic of oxy- and methæmoglobin. (ii) Large, dark sediment, consisting of much débris and casts. Albumin present: almost solid on boiling. Bile rarely present.

Blood.—Red cells reduced to 1,000,000. Hæmoglobin 20 per cent. Colour index normal. Red cells little changed, but 'shadow' cells present. During attack: polynuclears form 90 per cent of leucocytes. During recovery: mononuclear increase, leucopenia, nucleated red cells, punctate basophilia.

Sequelæ.—

POST-HÆMOGLOBINURIC FEVER.—Occasional pyrexia frequent for several weeks: may end in hyperpyrexia.

RELAPSES.—Shortly after attack, quinine will often cause relapse.

RECURRENCES.—Frequently occur: do not increase in severity.

Diagnosis.—From: (1) Yellow fever; (2) 'Bilious remittent fever' of malaria. In blackwater fever, rigor, pyrexia, and hæmoglobinuria occur together at onset.

Prophylaxis.—Residents in blackwater fever districts should take quinine *regularly*, and continue same dose for six months after returning to temperate climes.

Treatment.—

GENERAL MEASURES.—Absolute rest in bed. Large quantities of bland and alkaline fluid, by mouth, enemata, and subcutaneously (if vomiting). Glucose. Cardiac stimulants.

ALKALIS.—Sufficient to keep urine alkaline (diminishes blockage of tubules by hæmoglobin products)—e.g., pot. citrate $\bar{3}j$, every four hours.

BLOOD TRANSFUSION.—If attack severe.

SUPPRESSION OF URINE.—Fomentations to loins. Avoid diuretics.

QUININE.—*Not to be given during attack*, except on first day if parasites numerous (atebrin is recommended).
After convalescence, patient should leave malarial districts and should not return: especially after a second attack.

AMOEBC DYSENTERY.

(See DYSENTERY, p. 92.)

CHAPTER XXIV.

TRYPANOSOMIASIS.

(*Sleeping Sickness.*)

An infection by trypanosomes producing long-continued pyrexia and glandular enlargement and, if untreated, finally a prolonged fatal lethargic condition.

History.—Progress in discovery of trypanosomes has been:—

1. Non-pathological and in animals: GRUBBY, 1843, in frogs; later others found in birds and fishes; LEWIS, 1878, in rats (*T. lewisi*).
2. Pathological and in animals: 1880, EVANS, in Surra, disease of horses (*T. evansi*); 1895, BRUCE, in Ngana, tsetse-fly disease in S. Africa (*T. brucei*).
3. Pathological and in man: 1901, DUTTON—pathological nature not recognized; 1903, CASTELLANI, followed by BRUCE and NABARRC, in blood and cerebrospinal fluid of 'sleeping sickness' (*T. gambiense*). Other human pathological strains described: *T. cruzi* (CRUZ and CHAGAS, 1909); *T. rhodesiense* (STEPHENS and FANTHAM, 1910) (see p. 190).

Note.—This chapter refers to human trypanosomiasis or 'sleeping sickness'.

Distribution.—Gambia, Sierra Leone, and West Africa were original districts of *T. gambiense*. From Congo spread to Uganda, causing enormous mortality. Rhodesia subsequently became infected (*T. rhodesiense*). Both natives and Europeans susceptible.

Mode of Infection.—Infection is conveyed only by tsetse fly (except by transmission of infected blood), of species:—

1. *Glossina palpalis* (*T. gambiense*).—Breeds solely on lake and river banks in bush or forest. In addition to man, *big game* form a reservoir without production of symptoms. Possible other tsetse flies convey infection.
2. *Glossina morsitans* (*T. rhodesiense*). Prevalent in Rhodesia. Breed in any locality.

Direct mechanical transmission by other biting insects can occur.

Trypanosomiasis, *continued*.

Trypanosoma gambiense.—

MORPHOLOGY.—*Protozoa*, subclass *Flagellata*. Stained by Leishman's or similar methods, possess following characteristics:—

1. Unicellular: roughly fusiform shape: length about 30 μ ; breadth 1.5 to 3 μ (variable): protoplasm stains blue and contains two nuclei.
2. *Macro- or trophonucleus*: near middle: stains purple-red.
3. *Micro- or kinetonucleus*: near posterior end: small: stains intense deep purple-red.
4. *Undulating membrane*: commences near kinetonucleus: margin stains purple: runs entire length, and is continuous with
5. *Flagellum*: at opposite end to kinetonucleus. Since progression is usually in direction of flagellum, this is regarded as *anterior* end.

In fresh blood: is actively motile, by movements of undulating membrane and flagellum.

CULTIVATION.—In Novy and McNeal's medium (broth with twice volume of defibrinated rabbit's blood).

LIFE CYCLE.—Two phases: (1) In blood of vertebrate host (man or big game); (2) In gut of blood-sucking invertebrate host (*Glossina*). Life cycle and possibility of sexual stages at present incompletely known.

In *Glossina palpalis*: Trypanosomes enter with sucked blood: reach gut. None on proboscis after forty-eight hours. After five to seven days none present in gut. Subsequent stages unknown, but reappear in gut (in small proportion of flies) in large numbers after eighteen to twenty-five days: whence reach salivary glands in position for infection. Thus until about the thirty-second day fly does not convey infection by biting.

[*T. lewisi* in rat-flea, and also in cultures, passes through spherical stages resembling *Leishmaniae*. Multiplication of trypanosomes can occur by amitotic division, longitudinally, commencing with kinetonucleus, flagellum dividing last: thus forming a rosette with numerous daughter-trypanosomes united by flagellum before final separation. Before division breadth greatly increases. In all trypanosomiasis forms vary greatly in breadth, but it is unknown whether these are sexual forms.]

Trypanosoma rhodesiense.—Indistinguishable in man from *T. gambiense*. In rat, produces stumpy forms with nuclei placed posteriorly in non-flagellar end. This resembles *T. brucei*. May be a distinct species or a human strain of *T. brucei*, or *T. gambiense* transmitted through *G. morsitans*.

Prophylaxis.—Three factors to be considered to prevent spread:—

HUMAN HOST.—Prevention of movement of natives from infected to uninfected districts. Natives may carry trypanosomes in

blood with occasional pyrexial attacks but *without developing sleeping sickness*; hence isolation of all infected natives after examination (recognized by adenitis).

TSETSE FLY.—*G. palpalis* breeds on water banks: these can be cleared. *G. morsitans*, however, breeds too widely for attack.

BIG GAME.—Big game acts as a reservoir, but the extent of its influence is uncertain.

Morbid Anatomy.—Nothing distinctive except in brain.

BRAIN.—Fluid increased: convolutions flattened. Often a terminal purulent meningitis.

HISTOLOGY OF CENTRAL NERVOUS SYSTEM.—A characteristic meningo-encephalomyelitis, most marked at base of brain and medulla (Mott): great infiltration of mononuclear leucocytes in perivascular spaces, sufficient to interfere by pressure with circulation and hence with nutrition of nerve cells.

LYMPHATIC GLANDS.—Enlarged in early stages (pea to bean).

Symptoms.—

T. GAMBIESE.—*Incubation period*: 2 or 3 weeks or less; in animals 5 days. Two stages; transition gradual.

STAGE 1: TRYPANOSOME FEVER.—Onset gradual. Duration: several months, slow progress. Trypanosomes in blood and gland fluid, but not in cerebrospinal fluid.

Fever.—Irregular. Continuous, intermittent, or remittent, or with apyrexial intervals.

Pulse.—Rapid, 100 to 120. *Respiration* rapid.

Lymphatic Glands.—General enlargement, especially in posterior cervical triangle. At first painless, later hard and painful. No suppuration.

Eruption.—Transient pink circinate erythema on trunk.

Edema.—Local areas: face, ankles, etc.

Spleen enlarged; may be enormous. Also *Liver*.

Deep hyperæsthesia, to blows (Kérandel's sign).

General Symptoms.—Anæmia, tachycardia, debility progressing to muscular weakness and apathy. Intellect clear.

STAGE 2: CEREBRAL STAGE ('Sleeping Sickness').—Trypanosomes in cerebrospinal fluid. Progress usually insidious and chronic: occasionally rapid.

Expression becomes vacant and sad. Headaches. Tremors of tongue, and later of limbs. Glandular enlargement increases. Cerebration becomes slower: apathy and disinclination to work. Gait shuffling.

Further Progress.—Drowsiness marked. Weakness increases until patient is bed-ridden. Emaciation rapid.

Final Stage.—Patient is comatose. Lies on side with limbs flexed. Anæmia. Temperature subnormal: may be 92° or 94°. Death in lethargy or terminal purulent meningitis.

TOTAL DURATION.—Often about a year, but may be much longer.

Trypanosomiasis—Symptoms, continued.

T. RHODESIENSE.—*Incubation period*: short, 1 to 2 weeks. Tends to be acuter and more rapid than *T. gambiense* infection. Temperature higher. Glandular enlargement not so marked. More resistant to treatment.

Prognosis.—Without treatment, spontaneous recovery may occur in first stage, never in second. Many recoveries even in second stage under tryparsamide treatment: percentage at present uncertain.

Diagnosis.—Suggested by general glandular enlargement. Confirmed by presence of trypanosomes. Earliest: by puncture of lymph glands; trypanosomes present early in numbers. In blood, scanty; necessary to centrifugalize 10 c.c. citrated blood. In later stages in cerebrospinal fluid; also lymphocytosis. *Blood*: increased percentage of lymphocytes and large mononuclears.

Treatment.—Modern arsenical drugs have cured many cases, especially in early stages.

TRYPARSAMIDE.—Only drug effective in second stage. Many recoveries in *T. gambiense* infections, but not all cases respond. Visual changes may occur, usually transient: but may be blindness; also jaundice. Of little use in *T. rhodesiense* infections.

DOSAGE.—*Inject* intravenously or intramuscularly: initial, 1 gm. in 10 c.c. water; subsequently 2 gm. three times weekly, to total of 24 gm.

GERMANIN (Bayer 205).—Most effective drug in early stage. Is also effective in *T. rhodesiense* infections. Little use in second stage. May cause albuminuria, transient.

DOSAGE.—Intramuscular injections, 1 gm. in 10 c.c. water. Repeat weekly up to 10 gm.

If trypanosomes return, treatment may be altered from either of above drugs to the other. Tartar emetic also may be given simultaneously. Neocryl is under trial.

ATOXYL.—Not so effective as above. Often causes optic atrophy.

SOUTH AMERICAN TRYPANOSOMIASIS.

(*Chagas' Disease.*)

An infection by *Trypanosoma cruzi*, producing acute pyrexia with glandular enlargement, and in survivors a chronic stage with insufficiency of thyroid and other internal secretions.

Trypanosoma cruzi.—Intermediate host is a bug. In man, trypanosomes in blood for about 2 weeks: then pass into internal organs and assume leishmanial form, occasionally producing trypanosomes which enter peripheral blood. Animals are also hosts (armadillo).

Symptoms.—Infants of 1 year chiefly affected. Acute and chronic stage. *Incubation period*: 8 to 10 days.

ACUTE STAGE.—Principal symptoms: (1) Pyrexia; (2) Thyroid and superficial lymphatic glands enlarged; (3) Œdema and effusions; (4) Spleen and liver enlarged and tender.

Acute stage may be fatal in one month, terminating with meningeal symptoms: may pass into chronic stage.

CHRONIC STAGE.—Many groups of manifestations, including: (1) Myxœdema; (2) Goitre and cretinism; (3) Cardiac disturbances; (4) Nervous symptoms, with paresis and mental changes.

Treatment.—No specific treatment. Trypanocidal drugs have no effect.

CHAPTER XXV.

LEISHMANIASIS.

(*Kala-azar. Tropical Sore.*)

A group of diseases caused by flagellate protozoa of the genus *Leishmania*. Two divisions: (1) **GENERAL INFECTIONS:** (a) Kala-azar (*Leishmania donovani*—'Leishman-Donovan bodies'); (b) Infantile kala-azar (*L. infantum*). (2) **DERMAL INFECTIONS:** (a) Tropical sore (*L. tropica*); (b) Espundia (*L. brasiliensis*).

KALA-AZAR.

(*Dum-dum Fever. Tropical Splenomegaly.*)

Characterized by irregular pyrexia, splenomegaly, and cachexia.

Distribution.—Widely throughout Asia, also in Sudan and along shores of Mediterranean: in districts with considerable rain-fall.

Parasite (*Leishmania donovani*): Leishman-Donovan Bodies.—

MORPHOLOGY.—In smears from spleen with Romanowsky stain: Small 'cockle-shaped' bodies, about 2.5 to 3.5 μ ; protoplasm pink or blue, and contains (a) small nucleus near periphery, staining intense red; (b) larger nucleus nearer centre, staining less deeply; also usually vacuoles. In smears lie free, but in sections are mainly intracellular in larger endothelial cells, known as Leishman-Donovan bodies.

CULTIVATION.—Cultivated in hæmoglobin-agar (N N N medium), a motile *flagellate* organism develops. Resembles to some extent trypanosomata, but no undulating membrane. Life cycle incompletely known.

OCCURRENCE IN BODY.—Distribution general, especially in spleen, liver, and bone-marrow. Also in blood in *very small numbers* in leucocytes.

Leishmaniasis—Kala-Azar, continued.

Mode of Infection.—Probably by sandfly, *Phlebotomus argentipes*, but experimental infection of man never achieved. Natives have no immunity. Dogs occasionally suffer, but animals difficult to infect (hamsters readily).

INCUBATION PERIOD.—Long, but unknown.

Symptoms.—Onset insidious or sudden with high fever. Principal symptoms:—

1. *Pyrexia*. Irregular: may be day and night rise. Occurs in bouts of few weeks, with increase of symptoms.
2. Spleen greatly enlarged. Liver edge palpable. Abdomen becomes prominent.
3. Loss of weight, sweats, and debility. Skin: dusky pigmentation. No adenitis.
4. Anæmia severe. Blood: marked leucopenia.
5. Diarrhœa. (Ulcers in intestine.)

LATER, IF UNTREATED.—Ascites. Œdema. Diarrhœa. Hæmorrhages from mucous membranes. Finally: death from exhaustion. Duration: about one to two years.

UNDER TREATMENT WITH ANTIMONY.—Symptoms improve and weight increases. Cure is permanent.

Diagnosis.—By symptoms, combined with absence of malarial protozoa, confirmed by discovery of Leishman-Donovan bodies in spleen or liver puncture (preferably cultured).

NAPIER'S ALDEHYDE TEST.—Add 1 drop formalin to 1 c.c. serum: shake and stand in room: serum at once turns viscid, and sets solid in few minutes. Useful for extensive examinations.

Mortality.—Formerly 80 per cent. Low with modern treatment.

INFANTILE KALA-AZAR.

Distribution.—Shores of the Mediterranean. Widespread.

Characteristics.—Mainly in children, ages two to five years. Symptoms as in adult form. Parasite named *L. infantum*, but indistinguishable from *L. donovani*. Dogs often affected, and may be canine strain.

TROPICAL SORE.

(*Oriental, Baghdad, or Delhi Sore, Tropical Ulcer, etc.*)

An infective granuloma of skin and subcutaneous tissues, due to *L. tropica*.

Parasite.—Present in juice from spreading edge of sore. Grows in hæmoglobin agar (N N N medium): takes several weeks. Resembles *L. donovani*.

Mode of Infection.—Infection conveyed by sandflies (*Phlebotomus papatasi*).

INCUBATION PERIOD.—Very variable: weeks to many months.

Symptoms.—Commences as small itching papule: on exposed sites. Gradually ulcerates and extends. No general dissemination: lymphatic glands not affected. Ulcer closely resembles gumma. Lesions may be multiple.
If untreated, heals in about a year, by granulation: much scarring.

SOUTH AMERICAN DERMAL LEISHMANIASIS.

(*Espundia*.)

An infective granuloma with tendency to secondary lesions of buccal and nasal mucosa. Occurs in South America.

Parasite.—*L. brasiliensis*, indistinguishable from *L. donovani*.

Mode of Infection.—Probably conveyed by sandflies.

Symptoms.—Commences as small papule, on arms or often on margins of ears: extends and may suppurate. Later, ulcers appear round margins of nose and mouth, extend, and cause destruction of tissue: bone not affected. No general dissemination.

If untreated, death occurs from sepsis and exhaustion.

GENERAL TREATMENT OF LEISHMANIASIS.

Antimony Preparations.—Specific cure for all forms. Tartar emetic originally employed. *Pentavalent compounds* now in use. Neostibosan: dosage—initial 0.2 gm., then 0.3 gm, intravenously for 8 to 15 days. Similar drugs under trial.

RESULTS.—Spleen diminishes: blood and general condition improve: parasites disappear. Mortality: about 10 per cent.

Section I.—Specific Infectious Diseases, *continued*.

D. DISEASES DUE TO METAZOAN PARASITES.

CHAPTER XXVI.

TREMATODE OR FLUKE INFECTIONS.

(Distomiasis.)

Four principal groups of fluke infections occur in man. Distribution is confined practically to tropical and subtropical regions, but persists in persons returning to cooler climates if untreated.

1. **Pulmonary Distomiasis** (*Endemic Hæmoptysis*).—

A fluke, *Paragonimus westermanii*, size 8 to 16 mm. long by 4 to 8 broad, present in lungs. Mainly in China and Japan.

SYMPTOMS.—(1) Hæmoptysis, slight or occasionally severe. (2) Cough. Condition often suggests tuberculosis. (3) Ova in sputum in large numbers: oval, about $100 \times 50 \mu$. Cerebral abscess may occur. No specific treatment.

2. **Hepatic Distomiasis**.—Many varieties of flukes. Man rarely infected. Cirrhosis of liver occurs, with ascites, etc.3. **Intestinal Distomiasis**.—Intestinal flukes.4. **Blood Flukes** (*Schistosomiasis*).—See below.

SCHISTOSOMIASIS.

(Bilharziasis. Endemic Hæmaturia.)

A chronic infection by species of blood flukes, symptoms being produced by passage of ova into bladder or rectum, and in some forms by changes in the spleen and liver.

The Parasite.—Sexes distinct: (1) *Male*, length 11 to 15 mm. by 1 mm. broad, sides curved to form an unclosed cylinder (the characteristic *gynæcophoric canal*), has two suckers, body covered by spinous prominences; (2) *Female*, much longer but filiform. When young, sexes are separate, but at maturity female enters gynæcophoric canal of male, projecting at each end owing to greater length. Ovum oval: size 160 by 60μ .

LIFE CYCLE.—Leiper, 1916, determined extravertebrate stages.

1. Parasites inhabit portal vein of man, grow to maturity; female enters gynæcophoric canal of male, together migrate to smaller veins of bladder or rectum; thinner female then continues alone and deposits ova.
2. Ova traverse tissues and reach bladder or rectum; an embryo is now present in ovum. On reaching water an active embryo, covered with cilia, escapes (miracidium).

3. Miracidium penetrates a fresh-water snail, reaches liver, forms sporocysts in enormous numbers, whence bifid-tailed cercariæ escape into the water.
4. Cercaria reaches skin or mucous membrane of man during washing or drinking, and penetrates, shedding its tail. Thence reaches portal vein, and attains maturity in about six weeks. Cercaria dies in forty-eight hours unless it finds a host.

LENGTH OF LIFE OF PARASITE.—Can remain active and produce viable eggs for thirty years.

TYPES.—Three types occur, with following differences:—

1. *Schistosoma hæmatobium* or *Bilharzia hæmatobia*.—(i) Ovum has a terminal spine; (ii) Ova penetrate bladder (rarely rectum), causing hæmaturia, and appear in urine; (iii) Miracidium set free from ovum enters a snail, *Bullinus contortus*. Male worm covered with tubercles.
2. *Schistosoma mansoni*.—(i) Ovum has a lateral spine; (ii) Ova penetrate rectum and colon, causing blood in stools; (iii) Miracidium from ovum enters a snail, *Planorbis boissyi*. Male worm more coarsely tuberculated. Spleen and liver may be affected (Egyptian splenomegaly).
3. *Schistosoma japonicum*.—(i) Ovum has no spine, but there may be a lateral knob; (ii) Ova penetrate large and small intestine—never bladder; (iii) Miracidium enters a snail, genus *Oncomelania*; (iv) Male worm has no tubercles. Spleen and liver may be affected (Katayama disease).

Distribution.—*S. hæmatobium* and *mansoni* infections: Widespread throughout North and South Africa, parts of India, and other countries: in Egypt, probably 80 per cent of population affected. *S. japonicum* infection: Valley of the Yangtze-kiang, Japan, Philippines.

Mode of Production of Symptoms.—Some constitutional disturbance when parasites reach maturity, possibly due to toxins. Characteristic bladder and rectal symptoms due to passage and deposition of ova, and sequelæ.

Morbid Anatomy.—Ova passing through tissues act as foreign bodies, causing irritation and fibrosis. On bladder wall form prominences, often near trigone, from collections of ova, many becoming calcified. Subsequently, cystitis and papillomatous growths of bladder and ulceration occur, and suppuration round bladder: occasionally malignant tumours. Equivalent changes in rectum and female genital organs, with papillomatous growths. Ova also occur in kidney and other tissues.

S. Hæmatobium Infection.

Symptoms.—

INITIAL STAGE.—Four to ten weeks after infection. Constitutional disturbances, fever, abdominal pain, cough, diarrhoea, urticaria. Interval of months or years before bladder affected.

Schistosomiasis—S. Hæmatobium Infection—Symptoms, continued.

BLADDER SYMPTOMS.—Occur in attacks: (1) Hæmaturia, especially at end of micturition; (2) Aching in perineum; (3) Frequency and urgency of micturition; (4) Ova in urine, with terminal spine.

COMPLICATIONS.—Chronic cystitis. Calculi in bladder. Urinary fistulæ from periurethral and perineal abscesses common. Calculi in kidney (occasionally).

Rectum occasionally affected as in *S. mansoni* (usually due to double infection).

BLOOD.—Eosinophilia, 5 to 10 per cent. Anæmia rarely severe.

DURATION.—Many years.

PROGRESS.—Condition becomes a chronic cystitis, not necessarily fatal, but if neglected ordinary sequelæ of sepsis, etc., follow. With suitable treatment health is maintained. Death from intercurrent disease or neglect of bladder.

S. Mansoni Infection.

Symptoms.—Similar to above in initial stage.

RECTAL SYMPTOMS.—Attacks of blood and mucus in stools with tenesmus: ova in stools with lateral spine.

COMPLICATIONS.—Papillomatous growths: prolapse common. Vaginitis. Bladder rarely affected.

Egyptian Splenomegaly or Banti's Disease.—Now ascribed to visceral effects of *S. mansoni*. Spleen and liver enlarge progressively: may be painful. Irregular pyrexia. Progressive anæmia. Wasting. Final stages of cirrhosis of liver: ascites. May be hæmorrhages. Duration: many years.

S. Japonicum Infection.

Symptoms.—

INITIAL STAGE.—Pyrexia, urticaria, various pulmonary symptoms. Eosinophilia. Long latent period follows.

SECOND STAGE.—Intestinal and dysenteric symptoms.

THIRD STAGE (Katayama disease).—Spleen and liver enlarged. Wasting. Anæmia and ascites. Occurs only with severe infections. Duration: many years.

Diagnosis of Schistosomiasis.—Ova are characteristic. Eosinophilia. Diagnosis from kala-azar.

Prophylaxis.—Eradication of snails only possible in limited areas: re-infection invariable. Provision of pure water-supply, education of population in hygiene, repeated treatment on re-infection, are indicated.

Treatment.—

TARTAR EMETIC (Christopherson).—Specific cure. Intravenous injections only (solution causes necrosis of tissue). *Solution:* 1 or 2 per cent in normal saline (gr. $\frac{1}{2}$ to 1 in 3 c.c.), prepare

within few hours of use. *Dosage*: commence with gr. ss, increasing to gr. ii: twelve injections on alternate days: total 20 to 30 gr. Kills adult parasites. Results checked by examinations for ova.

FOUADIN, NEOANTIMOSAN.—Intramuscular injections of 7 per cent solution. *Dosage*: 5 c.c., 10 to 15 injections in 3 to 4 weeks. (First dose 1.5 c.c.) May be spasms of coughing.

EMETINE.—Intramuscular injections: useful for children.

Results of Drug Treatment.—Tartar emetic most satisfactory, eradication in almost 100 per cent. Other drugs above also successful. Re-infection frequent in infected areas, but yields to repetition of treatment. In Egypt, severe complications (calculi, splenomegaly) apparently diminishing.

SPLENECTOMY.—Has been widely employed in the past. Mortality said to be 15 per cent. Results still under discussion.

CHAPTER XXVII.

DISEASES CAUSED BY CESTODES.

(*Tæniasis.*)

1. INTESTINAL TAPE-WORMS.

Tæniæ or 'tape-worms' are flat, with a varying number of segments. Adult parasites, the sexual stage, live in the small intestine: the larvæ in the muscles and solid organs. Man is infected by ingesting the larvæ in meat and fish which is raw or insufficiently cooked. Animals are infected by ingesting ova. The most important varieties in man are: (1) *Tænia solium*, pork tape-worm; (2) *Tænia saginata* or *mediocanellata*, beef tape-worm; (3) *Tænia echinococcus*, larval. Less frequent are: (4) *Tænia cucumerina*, common in dogs and occasionally in children. Intermediate host: dog-fleas and lice. Head, 4 suckers and hooklets. (5) *Tænia* or *Hymenolepis nana*, dwarf tape-worm. Host: rats, mice, man. Infection from droppings of rats and mice. Length 5 to 45 mm.: about 200 segments. In warm climates only. Large numbers may be present. No intermediate host required, as ova hatch out in intestine. (6) *Dibothriocephalus latus*. (Syn.: *Diphyllbothrium latum*; *Bothriocephalus latus*.) In Finland, Baltic, and Switzerland; rare elsewhere; imported to United States. Host: man, dog. Intermediate host: pike and other fish. Can produce blood changes identical with pernicious *anæmia*, but curable on discharge of worm; probably only in persons with previous achlorhydria or partial deficiency of intrinsic substance, which worm absorbs. Very rare.

The principal characteristics are given in the table on p. 200.

Tænia Solium.—Life cycle: The uterus contains numerous ova. If ova are ingested into stomach of pig, embryo becomes free, penetrates wall, reaches muscles (also brain and liver), develops into

SPECIFIC INFECTIOUS DISEASES

INTESTINAL TAPE-WORMS.

CHARACTERISTICS.		<i>T. solium.</i>	<i>T. saginata.</i>	<i>T. echinococcus.</i>	<i>Dibothriocephalus latus.</i>
Distribution	.. .. .	Widespread in Germany; in England and America less common	Widespread; commonest type	Australia and Iceland very common; but widespread	Finland, Switzerland; rare elsewhere
Host (adult worms; in intestines)	.. .. .	Man only	Man only	Dog; also wolf and jackal (never in man)	Man, dog
Intermediate host (larval forms; in muscles and solid organs)	.. .. .	Pig: man occasionally	Cattle: never in man	Hog, sheep, ox, and man	Pike and other fish
Length	.. .. .	6 to 12 feet	15 to 20 feet	$\frac{1}{2}$ inch	25 to 30 feet
Head	.. .. .	Small pin's-head; 4 suckers; rostellum with hooklets	Larger than <i>T. solium</i> ; 2 mm. square; 4 suckers; no hooklets	4 suckers; double row hooklets (hooklets barbed)	2 lateral grooves; no hooklets
Proglottides	{ Number Size .. Shape ..	Many hundreds 10 X 7 mm. Elongated	Many hundreds 17 X 8 mm. Elongated	4 including head (rarely 3 or 5) Elongated	Many hundreds 10 X 2 mm. Broad and short
Sexual pore	.. .. .	Lateral	Lateral	—	Central
Uterus	.. .. .	Coarsely branched	Very finely branched	Only terminal segment mature	Rosette: in centre of proglottis
Ova	.. .. .	Nearly spherical; thick shell; contains embryo; (rarely visible hooklets)	As <i>T. solium</i> (differences slight); no hooklets	—	Segmentation marked

larval form or *cysticercus cellulosæ*, constituting 'measled pork'. *Cysticerci* are known as measles or bladder-worms. Frequent sites: tongue, muscles of mastication, shoulders, neck, diaphragm. In man, eating such pork, larvae develop into adult worms. Rarely larval forms occur in man (*see* *CYSTICERCUS CELLULOSÆ*, p. 202) *with serious results*.

Tænia Saginata.—Life cycle resembles *T. solium*, but cattle form intermediate host. *Cysticerci* most common in muscles of jaw. Larval forms never occur in man.

Tænia Echinococcus.—Only larval forms occur in man (*see* *T. Echinococcus*, p. 202). The following description of symptoms, etc., does not refer to this variety.

Symptoms.—Occur at all ages. May be no symptoms. Usual complaint is passage of segments. May be vague neurasthenic symptoms or gastro-intestinal disturbances—e.g., anorexia, capricious appetite with wasting, especially in children.

BLOOD.—Eosinophilia present usually.

Diagnosis.—Proglottides are pathognomonic. Ova in stools often distinctive.

Prophylaxis.—(1) Inspection of meat. *Cysticerci* in beef die in 3 weeks, but in pork live longer. (2) Sufficient cooking of meat. (3) Destruction by burning of all tape-worm segments passed in stools. Infected individuals should guard against auto-reinfection, especially with *T. solium*, in which case *cysticerci* may develop.

Treatment.—Must be thorough, with adequate preparation. In bed; three days on fluid diet; bowels must be opened freely:—

First evening.—Castor oil.

Second and third days.—In morning, saline (magnesium sulphate); in evening, cascara.

Fourth day (no food until treatment completed).—

8 a.m. Liquid extract of male fern, one drachm:—

R	Ext. Filicis Liq.	3j	|	Mist. Amygdalæ ad 3j
	Pulv. Tragacanth. Co.	3ss		

9 a.m. Repeat the draught.

11 a.m. Full dose of saline. Oil of turpentine, ℥30, in emulsion.

12 a.m. Enema if bowels not opened.

Filix mas is extremely unpleasant; patient must keep absolutely at rest and resist vomiting. Alternative method is: Capsules containing ℥15 to ℥30 each, three capsules at intervals of 15 minutes.

Motions after male fern to be passed into warm water, and the head must be searched for. If not found, repeat treatment in 10 days. If passed, tape-worm cannot grow again: but if retained, will re-form, segments appearing in 3 months.

If *filix mas* fails, try *pelletierine tannate* gr. vj to x (active principle of pomegranate bark): add few grains of tannic acid: purge an hour later. Also *carbon tetrachloride* in capsule (dose for adults, 3 c.c.): purge 3 hours later.

Diseases caused by Cestodes, *continued*.

2. CYSTICERCUS CELLULOSÆ.

(*Cysticercosis*.)

The presence in man of the larval form of *Tænia solium* (pork tape-worm) occurs rarely. The pig is the usual intermediate host for cysticerci. Man occasionally acts as such if ova enter the stomach.

Cysticercus Cellulosæ.—Elliptical shape, about 8 mm. by 6 mm. (one-third of an inch): semi-transparent (hence called 'bladder-worms'). Where pressure is slight, e.g., in ventricles of brain, may be larger.

Mode of Infection.—(a) Proglottides reach stomach by wandering or result of vomiting; or (2) Ova are ingested, from presence on fingers (auto-reinfection).

Distribution.—Sites are: (a) Subcutaneous and in muscle, usual site; (b) Central nervous system, occasionally; (c) Eye, rarely.

Symptoms.—Depend on site and number of cysticerci.

SUBCUTANEOUS AND MUSCULAR.—Usually no definite symptoms. If numerous, rarely severe pains. Cysticerci palpable as small, subcutaneous, often painful nodules.

CENTRAL NERVOUS SYSTEM.—In brain, produces epilepsy; also varied pressure symptoms: headache, various paralyses. Many cases recently recognized in British soldiers returning from India (MacArthur). Prognosis bad.

EYE.—May be present in vitreous humour.

Diagnosis.—By removal of subcutaneous nodules, or very rarely by presence in eye.

RADIOGRAPHS.—Cysticerci calcify in 4 to 5 years and are then (but not previously) opaque to X rays.

Treatment.—No special treatment.

3. TÆNIA ECHINOCOCCUS: HYDATID CYSTS.

Infection in man by larval forms of *Tænia echinococcus*. The characteristic of these larval forms (or 'hydatid cysts') is the power of multiplication. The adult worm never occurs in man.

Tænia Echinococcus.—For characteristics, *see* Table (p. 200).

Hydatid Cysts.—

DEVELOPMENT.—The terminal segment of the adult worm is discharged in dog fæces, and ova reach stomach of intermediate host. From ovum, six-hooked embryo ('oncosphere') escapes, penetrates stomach, and reaches various sites: liver, lung, etc. Hooklets are lost and cyst forms.

HISTOLOGY OF CYST WALL.—Two layers: (1) External, laminated, chitinous layer—'ectocyst'; (2) Internal, parenchymatous layer—'endocyst'. Surrounding layer of fibrous tissue forms from host.

DEVELOPMENT IN CYST.—From the 'endocyst' outgrowths form which develop into :—

1. **SECONDARY CYSTS.**—Exactly resembling primary cyst. These may become free. Also tertiary cysts may similarly develop, the whole attaining enormous size.
2. **SCOLICES.**—Immature heads of *T. echinococcus*, characterized by 4 suckers and hooklets. In intestine of dog a scolex develops into adult tape-worm.

'Daughter cysts' may be : (a) Endogenous : occur in man, developing within primary cyst as above. (b) Exogenous : usually in animals, buds penetrate cyst wall and develop externally ; never very large.

CONTENTS OF HYDATID CYSTS.—Clear fluid : no albumin (unless repeatedly tapped) ; specific gravity 1005 to 1010 ; contains chlorides. *Characteristics* : (1) Daughter cysts ; (2) Scolices, as above ; (3) Barbed 'hooklets'. Cysts are often sterile, and may contain neither scolices nor hooklets.

TERMINATION OF CYSTS.—(1) Death of parasites, followed by inspissation and calcification. Characteristic wall and hooklets may be present. Not uncommon. (2) Rupture. (3) Suppuration. The last two are serious.

Principal Situations in Human Body.—(1) Liver most frequent ; (2) Lungs and pleura. Less commonly kidneys, nervous system, omentum, stomach. No site is immune.

Hydatid Cyst of Liver.

Symptoms.—None when small. When large, may be dragging pain, or tumour in abdomen ; or cough, depending on direction of enlargement. General health unaffected unless complications occur, viz. :—

RUPTURE OF CYST.—Spontaneous or result of strain. Patient often conscious of 'something giving way'. Urticaria common. Directions : (i) Stomach and intestines, most frequent, may discharge for weeks, recovery, or death from suppuration. (ii) Lungs ; fragments of cysts coughed up. Often fatal from suppuration, hæmorrhage, gangrene of lung, suffocation. (iii) Peritoneum ; usually fatal peritonitis. Other directions may be : bile-ducts, extreme jaundice ; pericardium ; vena cava.

SUPPURATION.—With or without rupture. Symptoms of sepsis : rigors, sweats, pyrexia.

Physical Signs.—Depend on position of cyst. Most common in right lobe. Great enlargement of liver : (a) Downwards, resembling tumour of liver and appearing in epigastrium or hypochondria : especially if cyst on anterior surface or in left lobe. (b) Upwards : by compressing lung, closely resembles pleural effusion : heart may be displaced : especially with cysts on posterior surface and in right lobe.

Hydatid Cyst of Liver—Physical Signs, continued.

PALPATION.—Elastic sensation if cyst is large, occasionally with fluctuation. '*Hydatid thrill*': on sharp pressure with fingers a thrill may be momentarily felt, like 'quivering jelly', ascribed to impact of daughter cysts: rarely obtained.

Diagnosis.—

1. **CLINICAL.**—Great enlargement of liver, persistent, but associated with *good health*. Physical signs: elasticity, fluctuation, thrill, and painlessness.
2. **CYST FLUID.**—After aspiration: (1) Scolices; (2) Barbed hooklets. Either distinctive, but both may be absent if cyst sterile. Urticaria and toxic symptoms may follow aspiration.
3. **RADIOGRAPH.**—Cyst has definite outline.
4. **BLOOD.**—Eosinophilia.
5. Complement deviation and precipitin tests. Intradermal reaction.

Differential Diagnosis.—

CARCINOMA OF LIVER.—Often difficult, except by absence of wasting and good general condition.

PLEURAL EFFUSION.—May be impossible clinically: differentiated by puncture fluid.

HYDRONEPHROSIS.—Catheterization of ureter may be necessary.

DILATED GALL-BLADDER.—Is usually mobile and the shape distinctive.

SYPHILITIC LIVER.—No fluctuation.

PANCREATIC AND SIMILAR CYSTS.

Hydatid Cyst of Lung.

Most frequent site next to liver. Symptoms result from effect on the lung tissue, pressure on bronchi, etc., which may produce: (i) Bronchitis; occasionally foetid bronchitis, bronchiectasis, gangrene. (ii) Compression of lung with signs of consolidation. (iii) Hæmoptysis. (iv) Cavitation. (v) Pleurisy and empyema. Condition often suggests phthisis. Prognosis serious. Hooklets may be present in sputum. X-ray of thorax often decisive; shadow of cyst has sharp, regular, curved outline.

Hydatid Cyst in Pleura.

Less common. Simulates pleural effusion. General health good until complications occur—viz., (1) rupture—into lung or occasionally external, (2) suppuration—when prognosis is serious.

Hydatid Cyst of Kidney.

Not common. May resemble hydronephrosis. Rupture into pelvis and passage of contents in urine, or into peritoneum and tissues.

Hydatid Cyst of Brain.

Rare. Symptoms of tumour, usually cerebral.

Treatment of Hydatid Cyst.—Treatment surgical. Cyst should be opened and evacuated. If suppurating, treatment as for abscess. Small cysts occasionally can be excised entire.

Aspiration, except for diagnosis, is not advisable, owing to frequent failure, and to risk of suppuration, extension, and toxic effect.

CHAPTER XXVIII.

DISEASES CAUSED BY NEMATODES.**1. ASCARIASIS.**

Ascaris Lumbricoides. (*Round Worm.*)

Parasite.—General resemblance to the earth-worm. Cylindrical; pointed both ends; yellowish colour; transverse striations; four longitudinal bands. Male: length 6 to 10 inches. Female: length 8 to 16 inches.

OVA.—Oval: very thick capsule: no sign of embryo: numerous in fæces, stained brown by bile. Size: 0.08 by 0.06 mm.

LIFE CYCLE.—No intermediate host. After ingestion of ova, embryos hatch in upper portion of small intestine, penetrate mucous membrane, enter blood-stream, and reach liver. After a few days embryos enter hepatic veins, pass through the heart to the lungs, escape into the bronchi, pass up trachea, and down œsophagus to stomach and intestines, where they reach maturity one month after ingestion (Low); compare ANKYLOSTOMIASIS (p. 210).

MODE OF INFECTION.—By water. By vegetables supplied with infected water. By auto-infection.

NUMBER.—Often one or two. May be very numerous.

Symptoms.—Often none. In children, especially if nervous, may be various vague symptoms of disturbed digestion: irritability; nose picking; teeth grinding. Cough and perhaps broncho-pneumonia probably may result from migrations of embryos.

Wanderings of adult worms often extensive: into bile-ducts, producing jaundice; into appendix; into stomach, subsequently being vomited and withdrawn by subject from pharynx. Rarer situations: perforation of intestine and peritonitis; pancreatic duct and fatal pancreatitis. Few possible sites have escaped.

EOSINOPHILIA may occur to moderate extent, but often absent.

Treatment.—Give castor oil at night. Next morning, santonin with an aperient: e.g., for a child one or two years old:—

R	Santonin	gr. j-ij	{	Calomel	gr. ss
	Pulv. Scammonii	gr. ij			
		Ft. pulv.			

Ascaris Lumbricoides Infection—Treatment, continued.

At midday give a saline purgative. Repeat next day. Warn parents of effects of santonin—viz., urine coloured green, or red if alkaline; blue vision followed by yellow; may be vertigo.

For adult, santonin gr. v, with calomel and saline purgatives. Oil of *chenopodium* often effective. May be combined with carbon tetrachloride. Dosage as in ANKYLOSTOMIASIS (q.v.).

Oxyuris Vermicularis. (Thread Worm.)

Parasite.—Male: length 4 mm., tail coiled in spiral. Female: 10 mm., tail long and pointed. In faeces often in large numbers: resemble short pieces of thread, moving slowly.

Modes of Infection.—Occurs through water or infected vegetables. After ingestion of ova, worms mature in small intestine, then migrate to cæcum, where majority remain and ova are discharged. Some go to rectum, pass through anus, especially during warmth in bed, and cause great irritation. Resultant scratching leaves ova on fingers and reinfection follows.

Symptoms.—Mainly in children. Often previously in unhealthy condition, with disturbed digestion and excretion of mucus. Symptoms ascribed to infection: irritability, itching of anus and perineum, insomnia, picking nose; may become hysterical.

EOSINOPHILIA.—Occasionally present to slight degree.

Treatment.—Treat any disturbance of digestion, e.g., diminish sugar and carbohydrates: give aperients (hydrarg. c. creta). *Treatment of infection:* Nightly hot rectal washes; once weekly a simple soap and water enema, followed after return by enema of infusion of quassia, 6 to 10 ounces (for a child), hips to be raised and enema retained as long as possible (keep quiet and tie thighs together). For itching of anus, apply ung. gall. c. opio or carbolyzed vaseline. To prevent auto-infection, cover child's buttocks at night with drawers or tie nightdress below feet. Anthelmintics by mouth may be tried, as for ascaris and tænia.

2. TRICHINIASIS.*

Infection of the human being by *Trichinella spiralis* results in a stage of gastric irritation during the development of the adult worm in the intestine, and a more characteristic stage of myositis due to the migration of the embryos to the voluntary muscles.

Parasite.—

- 1. ADULT FORM.**—Both sexes are cylindrical, the oral end being pointed. Male: length about 1.5 mm.: two projections from posterior end resembling the jaws of a pair of pincers hold the female in coitus. Female: length 3 to 4 mm. Characteristic:

*The terminology has become confused. The original name, *Trichina spiralis*, given to the parasite was not admissible, as *Trichina* was previously in use, hence it was altered to *Trichinella spiralis*. The clinical condition is often referred to as 'Trichinosis', but more correctly is 'Trichiniasis', or most correctly 'Trichinelliasis'.

the œsophagus is lined by a *single layer of large cells*, readily recognized at the anterior portion of the parasite, and known as the 'cell body'.

2. **EMBRYOS.**—Minute organisms.

3. **LARVAL FORM**, or muscle trichinellæ. Oval laminated capsule, length about 0.6 to 1 mm.: contains a distinct coiled worm with pointed head and rounded posterior end. In early stages capsule translucent; subsequently impregnation with lime salts occurs, and then it is easily visible with a hand lens. May be two, and rarely three or four, worms in single capsule.

Mode of Infection.—In man by eating trichinous pork. No intermediate host is necessary, and thus among hogs in large herds probably spreads by feeding on offal of other infected animals. In hog, symptoms are slight even with large infections; also calcification of capsule is less common and cyst more difficult to recognize. Rats may be true host of *T. spiralis*.

Muscle trichinellæ are resistant to heat, but destroyed at boiling-point, i.e., by thorough cooking of pork; but at centre of a joint temperature may be insufficient.

Geographical distribution is universal, but human infection is rare except in North Germany, where raw ham is consumed. Tends to occur in small outbreaks, but isolated cases are not infrequent.

Cycle in Human Body and Mode of Spread.—

1. On ingestion of muscle trichinellæ, capsule is digested and larval trichinellæ enter the duodenum and jejunum.
2. By the third day, the adult worm is fully grown and sexually mature.
3. By the sixth to seventh day, the embryos are fully developed. The adult female is ovo-viviparous, discharging free embryos in large numbers from the uterus; dies after discharging embryos for five or six weeks, many hundreds.
4. *Fate of the adult worms.*—Male dies after copulation.
5. *Spread of embryos.*—The female penetrates intestinal wall, and discharges embryos into lymph spaces, whence they enter veins, reach intermuscular connective tissue, and finally enter *voluntary muscle fibres*. Embryos have been found in the blood between the 7th and 25th day; also numbers have been found in peritoneal and other serous sacs.
6. *Embryos in the muscle.*—The embryo coils, becomes less active, and in two weeks from ingestion of meat definite 'muscle trichinellæ' are present. A local myositis results and an oval capsule forms, probably from the muscle. The formation of the capsule takes about six weeks. If fresh muscle be teased on a warm slide, embryo may be seen to move; can remain alive for many years, but undergoes no further development.

Calcification of capsule: in man occurs in four to five months, kills embryo, and also renders capsule visible.

Trichiniasis—Cycle in Human Body and Mode of Spread, *continued*.

7. *Muscles affected*—Most frequent are the diaphragm, intercostals, muscles of neck and eyes, and larger voluntary muscles, especially near tendinous insertions of voluntary muscles; in man biceps and gastrocnemius especially liable.

Symptoms.—

The severity of symptoms depends on extent of infection and also on number of embryos developed in small intestine. May be very slight, or merely *vague rheumatic pains*. When severe, following stages are definite:—

STAGE OF GASTRO-INTESTINAL IRRITATION.—Corresponds to development of adult worms in small intestine, sexual activity, and possibly penetration of gut by females. *Onset*: may be within twenty-four hours, usually two to three days after ingestion. *Abdominal pain, vomiting, and often diarrhoea*.

May be absent, or of choleraic severity with muscular cramps: intensity is no guide to subsequent stage, as vomiting and diarrhoea may discharge many adult worms before embryos are free.

STAGE OF MYOSITIS.—Corresponds to migration of embryos and capsulation in muscles. *Onset*: 7th to 14th day, usually 9th or 10th.

- (1) *Fever*: 102° to 104°, remittent or intermittent. (2) *Myositis*: Muscles swell, become hard, very tender, and all movement painful. Position in bed: limbs semiflexed to relax muscle, most typical being *flexed forearm* owing to great infection of biceps. Other special muscles commonly affected are: (a) Diaphragm (cough and respiratory troubles, may be extreme dyspnoea); (b) Muscles of mastication and larynx (aphonia); (c) Muscles of the eye; (d) Gastrocnemius. (3) *Œdema*, important sign: (a) In face: early transient œdema about 8th day. (b) In 4th or 5th week: œdema, often extreme, of face, limbs, and entire body (genitals may escape). Urticaria and sweating. Albuminuria is rare. (4) *Eosinophilia*: Extreme, total leucocytes 20,000 to 30,000 per c.mm., and eosinophils may be 50 per cent. In severe infections, pulmonary symptoms, rapid emaciation, and toxæmic state may develop.

Duration.—Depends on extent of infection. Mild cases recover in two weeks. *Severe cases* convalescent in six to eight weeks—sometimes termed 'third stage of subsidence'. Many months of weakness follow.

Prognosis.—Best in children, and with much early diarrhoea resulting in excretion of adult worms.

MORTALITY has varied greatly in different outbreaks: depends on degree of infection of flesh at fault; varies from 1 to 30 per cent, but often 25 per cent. *Death* usually occurs in 4th to 5th week while myositis severe. From: (1) Weakness of diaphragm and intercostals, and extreme dyspnoea; (2) Pneumonia; (3) Typhoidal state.

Diagnosis.—In epidemics, diagnosis often simple. Diagnostic methods are :—

Suspected food.—Tease on slide and examine by hand lens or microscope for larval forms.

Parasites in human faeces.—Dilute faeces in conical glass : examine sediment against black background for minute parasites ; under microscope identify by 'cell-body'.

Excise small slips of biceps or deltoid of patient and examine. *Eosinophilia.*

X rays show calcified cysts.

DIFFERENTIAL DIAGNOSIS.—

TYPHOID.—In trichiniasis : no headache, no splenic enlargement, no spots, but pain and swelling of muscles and oedema. Also eosinophilia.

RHEUMATIC FEVER.—Distinguish by gastro-intestinal stage.

BERI-BERI may simulate closely. No eosinophilia.

Treatment.—Indication is to empty intestine early in order to discharge worms. Give calomel in large doses, e.g., gr. ij, t.d.s. Glycerin advocated in large doses to dehydrate worm ; doubtful value. Anthelmintics are useless. No drugs affect the muscle trichinellæ. Muscle pain needs morphia.

Prophylaxis.—Thorough cooking of all pork is best, and is efficient prophylactic measure, with rare exceptions.

In herds of hogs, measures advised are : (1) Destruction of rats ; (2) Uncooked offal of hogs not to be used as food ; (3) Examination of flesh in the abattoirs.

3. ANKYLOSTOMIASIS.

(Hookworm Disease. *Uncinariasis.*)

Synonyms.—In Europe, *Ankylostomiasis* (various spellings). In America, *Hookworm disease* or *Uncinariasis*. Popular terms : miners' anæmia, tropical chlorosis, tunnel disease.

Geographical Distribution.—In tropical and subtropical countries : widespread. In parts of India and Porto Rico 60 to 90 per cent of population affected. Very prevalent in Southern States. Small epidemic in Cornwall in 1900.

Parasite.—Two principal sub-groups of *Uncinaria* : (1) *Ankylostoma duodenale*, in Old World ; (2) *Necator americanus* or *Uncinaria americana* (hookworm), in New World. Both are small, cylindrical nematodes.

1. **ANKYLOSTOMA DUODENALE.**—Mouth is large orifice with two pairs of hook-shaped ventral teeth. Male : length 10 mm. ; at posterior end is an expansion, the 'caudal bursa'. Female : length 10 to 18 mm.

2. **NECATOR AMERICANUS.**—Differs from last in having 4 sharp lancets external to mouth on dorsal aspect, also single tooth and pair of semilunar plates in place of hook-shaped teeth. Other slight differences.

Ankylostomiasis—Parasite, continued.

OVA.—Characterized by segmentation within capsule: usually 4 or 8 cells when examined from fresh fæces. Often in enormous numbers. Size 60 to 75 μ by 35 μ .

LARVÆ.—Embryos may be born one to two days after ova leave body, depending on warmth and moisture. Embryos then moult twice, after which they are infective. Can occur within four to five days. May live for months subsequently. Development most favourable in fæces mixed with earth.

Mode of Infection.—Domestic animals are not infected. Infection of human being occurs:—

1. **THROUGH THE SKIN** (Looss, 1898). Usual method. Larva penetrates skin, enters veins, passes through heart to lungs, escapes into bronchi, passes up trachea and down œsophagus to stomach and intestines, course occupying seven to ten days. (See *ASCARIS LUMBRICOIDES*, p. 205.) In the intestine, larva moults again, and then matures. Ova are present in fæces in about seven weeks from entry.

2. **BY THE MOUTH.**—Rare. By water supply, infection of fingers.

MODE OF ACTION IN HUMAN BODY.—The adult worm lives in the jejunum: by its teeth and lancets it pierces the mucosa and sucks blood. Probably also secretes hæmolytic toxin from head glands and diminishes coagulability of blood.

Morbid Anatomy.—In mucosa of jejunum, ecchymoses and erosions present: worm often attached in centre. Also oozing points, probably vacated by worms. In long-standing cases, mucosa pigmented and infiltrated. Often blood cysts, length $\frac{1}{2}$ to 1 inch, containing one or two worms. Intestinal contents often blood-stained. Fatty degeneration of heart and other organs, if anæmia advanced.

Degree of Infection in Relation to Symptoms.—Infection with few worms is of little importance. From experience in dealing with infections in large populations, the Rockefeller Institute and other workers have arrived at the following methods and conclusions:—

EXAMINATION OF STOOLS FOR OVA.—Flotation method: Ova float in saline of sp. gr. 1.130 while other fæcal matter sinks; ova removed from surface on glass slide.

COUNT OF OVA IN STOOLS.—Stoll's method: measured amount of stool diluted quantitatively and ova counted in measured quantity.

RELATION OF OVA TO WORMS HARBOURED.—It is estimated that 44 ova per 1 gm. formed stool corresponds to one female worm.

SEVERITY OF INFECTIONS.—Cases are grouped according to number of worms thus estimated to be harboured:—

1. **INFECTION VERY LIGHT**, 1 to 25 worms; or **LIGHT**, 26 to 100. Harbourners have no obvious symptoms: constitute 'carriers'. No drastic treatment urgently necessary.

2. **INFECTION MODERATE**, 100 to 500 worms. Patients physically and mentally 'below par'; no gross illness, but symptoms as below in varying degree. May include a large percentage of the population, especially children. One standard course of treatment.
3. **INFECTION HEAVY**, 500 to 1000; or **VERY HEAVY**, 1000 to 3000 worms. Serious symptoms as below. Constitute only a small percentage of total affected. Two standard courses of treatment.

Symptoms.—

'GROUND ITCH' occurs at site of entry of larvæ. Vesicular eruption, becoming pustular ('bunches'). Commonly under toes. In miners often on arms and hands. Heals in one to two weeks.

ESSENTIAL SYMPTOMS.—(i) *Anæmia*, with *palpitation*, *œdema*, and *lethargy*. (ii) *Digestive troubles*: *Epigastric pain and tenderness* very constant, even in mild cases. In severe forms, anorexia and, characteristically, *perversion of appetite*, especially dirt-eating ('pica', 'geophagy'). Wasting not common; usually plump. Bowels variable: constipation or irregular diarrhœa. (iii) *Mental inertia*: Listless expression, lack of concentration. (iv) *In children*: Under-development; small stature; puberty delayed: growth may continue until twenty-five years.

No enlargement of glands, spleen, or liver.

OTHER SYMPTOMS.—*Fever*: Variable, often transient rises. *Blood changes*: (a) *Erythrocytes*: microcytic anæmia. Hæmoglobin 40 to 50 per cent, rarely lower. Colour index low. Changes in form of red cells slight: occasionally nucleated cells and megaloblasts: blood may be suggestive but is not typical of pernicious anæmia. (b) *Leucocytes*: *eosinophilia*: 15 to 25 per cent; in recent infections often higher. No leucocytosis. *Fæces*: Occult blood, but obvious hæmorrhage rare.

Duration.—Chronic: often many years. Rarely acute.

Termination in Severe Infections.—Anæmia extreme with usual sequelæ. Cachexia. Œdema. Serous effusions. Death from exhaustion or intercurrent disease.

Diagnosis.—In infected districts suggested by anæmia, especially with history of 'ground itch', and in children associated with under-development and physical and mental inertia. Examine: (1) *Fæces* for ova (following a dose of thymol)—often segmented, 4 or 8 cells; or more complete embryo. (2) *Blood* for eosinophilia.

Treatment.—Essential treatment is to evacuate parasites from intestine. When this is accomplished, recovery is good. Test of success is absence of ova from stools during three weeks. With modern treatment worms are easily expelled, but reinfection is very common: frequently this is very light and further treatment is unnecessary. The following drugs have been extensively and successfully used:—

Ankylostomiasis—Treatment, continued.

CARBON TETRACHLORIDE (Hall).—Dosage, by mouth; 0.2 c.c. (Mij) for each year of age up to 15 years: for adults 3 c.c.: give in gelatin capsules or in a glass with a little water. Dose of magnesium sulphate three hours later. Two treatments usually suffice. Cheap and effective.

Note.—Must be free from sulphur, i.e., carbon bisulphide.

When pure is not toxic by mouth. No alcohol allowed.

OIL OF CHENOPODIUM.—In freshly-filled hard gelatin capsules: 1 c.c., repeated one hour later. Aperients two hours after. Repeat in ten days. Cheapest and efficient. Treatment combined with carbon tetrachloride is especially effective.

THYMOL.—Method: Saline purgative at night. Following day, thymol at 6 a.m., repeat at 8 a.m.; saline purgative at 10 a.m. Repeat weekly until cured. Dose of thymol: under five years, 7 gr., increasing to 30 gr. for active adult.

Precautions.—No alcohol or oil to be given during treatment: thymol is freely soluble in these, but only soluble 1 in 500 in water. Administration of such results in absorption of thymol, with vertigo, delirium, and occasionally fatal syncope. Contra-indicated in advanced cases, or with nephritis, or cardiac weakness.

EUCALYPTUS OIL and **BETA-NAPHTHOL** also in common.

Prophylaxis.—Important measures are: (1) Disposal of Special care in mines. Population educated to use pn.
(2) Pure water-supply. In absence of this, water to be boiled.
(3) Children to wear shoes and stockings.

The Rockefeller Institute has instituted an anti-hookworm campaign in infected districts in America with marked success.

4. FILARIASIS.

Infection by *Filaria bancrofti* (*Wüchereria bancrofti*) may result in obstruction of lymphatic vessels, of which the chief symptoms are chyluria and elephantiasis.

Geographical Distribution.—Widespread in tropics and subtropics. Occurs in Southern States. In Samoa affects nearly half the population.

Parasite.—

ADULT PARASITE.—Hair-like worm, length 2 to 4 inches, in many coils. *Site in body:* In thoracic duct, lymphatics, or glands, often in varices: never seen during life. *Life:* possibly years.

EMBRYO.—About 0.3 mm. × 0.01 mm. Structure slight. Is contained in a 'sheath', which it does not fill at the ends, and in which it moves back and forwards. Present in peripheral blood.

Life Cycle.—

1. Mosquitoes are intermediate host. Withdraw embryos from definitive host when feeding. In stomach of mosquito, embryo

ruptures sheath, reaches thoracic muscles, and there undergoes development for twelve to twenty days. Thence it passes to base of proboscis. When mosquito feeds, larva bursts from base of proboscis (not through salivary glands), escapes on to skin, and penetrates it near, but not at, puncture.

2. In man, these larvæ reach lymphatics, mature, and produce embryos, which pass through lymphatics to veins and into peripheral circulation.

Periodicity.—Embryos are present in blood only at night, about 6 p.m. to 8 a.m. During day, live in lungs and blood-vessels of thorax. Connected with nocturnal habit of usual intermediate host, viz., the mosquito *Culex fatigans* (*quinquefasciatus*).

NON-PERIODIC FILARIÆ.—In Fiji and islands near, embryos are present also during day. Parasite is identical, but intermediate host is the mosquito *Stegomyia pseudocutellaris* (*Aedes variegatus*), which feeds by day.

Pathology.—Embryos are harmless; being breadth of red cells, can pass through capillaries without blockage; often present in man without symptoms, and in animals. Symptoms produced by blockage of lymphatics by adult worms, by fibrosis which occurs extensively, and possibly by calcification of worms, or by ova prematurely expelled. Results are:—

1. Lymphatics enormously dilated round kidney, bladder, etc., forming varicose masses, and containing chyle. Thoracic duct may be stenosed. Groin glands often enlarged. Rupture of varices into urinary system causes *chyluria*. Parasite may be dead previously and no embryos in blood, but the latter are often present.
2. *Solid œdema or elephantiasis.*—Blockage of lymph vessels alone does not produce this (confirmed experimentally by ligature in animals), inflammation also necessary. This occurs in recurring elephantoid fever with lymphangitis, probably of septic origin.

RELATIONSHIP OF ELEPHANTIASIS TO FILARIASIS.—

Embryos are not present in blood: are found even to less extent than in unselected persons, probably owing to previous blockage of lymphatics. Relationship is inferred from: (i) Geographical distribution identical; (ii) Both are lymphatic diseases with recurrent lymphangitis; (iii) Elephantiasis is common sequel of, or coexists with, lymph scrotum, which is certainly filariasis.

Symptoms.—

1. **CHYLURIA.**—Passage of milky urine, usually blood-stained. No symptoms, or may be pain in back and pelvis. Occurs intermittently, at intervals of weeks or months, over many years: but if frequent, anæmia may result. Urine clots on standing. The pink coagulum contracts and expresses milky fluid. Later a layer of fat globules may form on surface. Clears with ether. Embryos often present in blood and urine.

Filariasis—Symptoms, *continued*.

2. **ELEPHANTIASIS**.—*Legs* most commonly affected, especially below knee. Scrotum not infrequent. Enlargements often enormous. Mammæ and arms less frequent. Slow and painless. Fluid is lymph, not chyle.

Elephantoid fever.—Recurrent attacks of fever, pain and swelling in limb, and lymphangitis. After attack, limb remains larger. Embryos not present in blood.

OTHER CONDITIONS are: '*Lymph scrotum*': Lymphatics dilated and varicose over scrotum: chyle discharges if vessels rupture. Subsequent elephantiasis common. '*Varicose groin glands*': Chronic, bilateral: frequently with lymph scrotum. *Lymphangitis*.

Diagnosis.—Generally simple, either by symptoms or by presence of embryos in blood. Eosinophilia.

Treatment.—Tartar emetic is best drug, but not specific cure. Inject intravenously 5 to 10 c.c. of a 2 per cent solution daily for three weeks: may be repeated.

CHYLURIA.—Rest, purge, dry diet, avoid fats. Disappearance of chyle does not prove rupture is healed: can be tested by drinking glass of milk and watching for reappearance of fat.

ELEPHANTIASIS.—Carefully protect from injury and sepsis.

ELEPHANTOID FEVER.—Rest, purge, cooling lotion to sites. Bandage firmly subsequently.

ELEPHANTIASIS OF SCROTUM.—May be removed by operation. '**GROIN GLANDS**' and '**LYMPH SCROTUM**'.—Operation inadvisable. In latter, elephantiasis of leg may follow.

General Characteristics.—(1) Embryos are only found in blood; (2) Sheath of embryo is incompletely filled; (3) Nocturnal periodicity; (4) Symptoms mainly (a) chyluria, embryos often present; (b) elephantiasis, embryos rarely present.

Varieties of Filaria.—

Of *Filaria sanguinis hominis* (embryos present in blood), three species are known:—

F. bancrofti: Described above. Sole cause of symptoms of chyluria and elephantiasis.

F. loa or *Loa loa*: Embryos present by day only. Adult worm wanders in connective tissues: may appear beneath conjunctiva. Urticaria may occur. Eosinophilia and leucocytosis. Probable cause of Calabar swellings: sudden, size of egg, painless, no inflammation, last a few days; ascribed to oedema of subcutaneous tissues; possibly anaphylactic reaction to toxins. Carrier is a *Chrysops*, mangrove fly, West Africa.

F. (Acanthocheilonema) perstans: Embryos alone known. No periodicity. Conveyed by *Culicoides austeni*.

Other species have also been described. Guinea-worm is a filaria.

5. DRACONTIASIS.

(Guinea-worm Disease.)

Infection by *Dracunculus (Filaria) medinensis*.

Geographical Distribution.—Certain parts of India and Africa, especially West Africa. Districts are fairly limited, probably by distribution of intermediate host.

Parasite.—*Female guinea-worm* is about 80 cm. long by 1.5 mm. in breadth: shape, cylindrical. On tail is a minute hook. Uterus occupies almost entire body, is packed with embryos, which are discharged by prolapse of the uterus through the mouth. Of the male, little is known: life probably much shorter and dies after coitus. Parasite enters human body by mouth in drinking water and reaches stomach. Female penetrates intestine after impregnation: reaches subcutaneous connective tissue: develops, and then wanders down in tissues usually to foot or ankle, where it lies subcutaneously. Here the skin is penetrated, a small vesicle forming and bursting: through this erosion the head can protrude, and embryos are discharged when site is in contact with water. Urticaria, fever, and even collapse may occur at time vesicle forms: relieved by injection of adrenalin. After all embryos are discharged, worm usually leaves host. Occasionally worm becomes calcified under skin.

Intermediate host in water is a minute *Cyclops*, a crustacean.

Embryo after entry undergoes certain changes and is then infective. Many features are related to this host: The guinea-worm travels to parts where it can discharge its embryos into water; in native water-carriers it often appears on back where bag rests; douching site of head produces a discharge of fluid containing numerous embryos. The life of the female guinea-worm is about a year, probably corresponding to some development of the *Cyclops*.

Treatment.—

1. After head appears, or when worm is within reach subcutaneously, inject its body with perchloride of mercury 1-1000; worm dies in twenty-four hours and can be withdrawn.
2. Douche site with water: as worm protrudes, roll it on a small stick. Repeat daily. Danger is that worm may break, when embryos are discharged into tissues and *extremely troublesome suppuration follows*. No traction must be used, as worm resists, probably by hook on tail.

By douching, discharge of embryos is complete in fifteen to twenty days, and worm is then absorbed aseptically, or leaves host spontaneously.

6. ONCHOCERCIASIS.

Infections by *Onchocerca volvulus* and *onchocerca cæcutiens* (may be identical).

Onchocerciasis, *continued*.

Geographical Distribution.—*O. volvulus*: West Africa, Sudan, Uganda. *O. caecutiens*: Guatemala.

Parasite.—Female, length 35 to 40 cm.; male shorter. Inhabits subcutaneous and connective tissues of man. *Simulium damnosum*, black jinja-fly, conveys infection in Africa; ingests embryos from blood; cycle as in *F. bancrofti*. (Other simulia in Guatemala.)

Symptoms.—

1. Subcutaneous tumours, may be 2 to 3 in. diameter: contain mass of parasites, microfilariae, in fibrous tissue. Elephantiasis may result from pressure.
2. Ocular disturbances and *complete blindness*: especially with tumours on the head: lesion may be (a) choroidoretinitis, (b) keratitis: mode of production doubtful.
3. Lichenoid dermatitis.

Treatment.—Tumours may be excised. Blindness permanent.

7. TRICHURIS TRICHIURA.

(Whip-worm. *Trichocephalus dispar*.)

Inhabits cæcum and large intestine of man. Distribution probably universal and occurrence frequent.

WORM.—Length about 2 inches. Shape resembles a whip: anterior portion very thin and posterior portion thick, being in female straight and in male coiled.

OVA.—Oval: dark brown. Characteristic *light-coloured protruding 'knob'* at each end.

MODE OF INFECTION.—Direct by water. No intermediate host.

SYMPTOMS.—None by which infection can be recognized. Possibly causes anæmia, but little known.

Section I.—Specific Infectious Diseases, continued.

E. DISEASES DUE TO SPIROCHÆTES.

CHAPTER XXIX.

RELAPSING FEVER. AFRICAN TICK FEVER.

RELAPSING FEVER.

An acute infectious disease caused by a spirochæte conveyed by lice, and characterized by alternate periods of fever and apyrexia of five to ten days' duration.

Distribution.—Occurs in all continents, with slight differences in spirochætes, mode of transmission, and symptoms. In Europe known as 'famine fever' or 'seven-day fever'; lingers in Ireland. Widespread in India. Not of recent years in United States.

Spirochæte.—*Sp. recurrentis* or *obermeieri* discovered in blood by Obermeier in 1873: invariably present during febrile periods, but not in intervals. It is unknown if periods correspond to developmental phases (as in malaria). Length 15 to 40 μ : numerous spirals: actively motile, by lashing movements or action of spirals. Cultured on Noguchi's medium.

NOMENCLATURE.—Originally termed spirillum.

Epidemiology.—Transmitted from man to man, conveyed by lice (*Pediculus corporis* and *capitis*). Spirochætes undergo developmental cycle in louse and become present in all body fluids after five to sixteen days. Infection from body fluids by scratching and not by bites. Louse infective for twenty-eight days: not transmitted by eggs. Human blood also directly infective. Animals not naturally infected, but experimentally susceptible. Laboratory infections common. Prevalent in winter months.

Morbid Anatomy.—No special changes except enlargement of spleen and liver.

Symptoms.—

INCUBATION.—From two to ten, usually five to seven days.

INVASION.—*Sudden onset*: rigors, headache, sweats, intense pains in long bones, giddiness, and often vomiting. *Temperature* 103° to 104° on first day. *Pulse* 110 to 180. *Spleen* enlarges, also liver. Slight jaundice; constipation or diarrhœa. Occasionally herpes. Rash rare: erythema or rose-coloured spots, commencing on neck. *Blood*: spirochætes present, polynuclear leucocytosis.

Relapsing Fever—Symptoms, *continued*.

CRISIS.—Usually fifth to seventh day of fever. Sweating: rapid apyrexia. Death at crisis may occur in weakly persons.

APYREXIAL PERIOD.—Duration about same as fever: rapid improvement, followed by—

RECURRENCE.—About fourteenth day. Similar to initial attack, but usually milder. Rarely more than one recurrence in European type: occasionally three or four. Absence of recurrence rare.

CONVALESCENCE.—Slow, owing to exhaustion.

RARELY, serious type with hæmorrhages and jaundice.

Complications.—Not common. Delirium during fever. During convalescence: rarely iritis, meningitis, paralyses, convulsions.

Prognosis.—In good conditions, mortality under 2 per cent, especially with modern treatment. With overcrowding and bad hygiene, rises to 20 or 30 per cent. One attack does not protect.

Diagnosis.—During febrile period, spirochætes in blood. In afebrile interval, blood will agglutinate spirochætes in infected blood (equal drops: incubate at 37° C. for half hour). In doubtful cases injection of blood into rats or monkeys (25 c.c.).

When treated with quinine in absence of blood examination, crisis may lead to diagnosis of malaria.

Treatment.—Arsenobenzol preparations are specific. Spirochætes disappear, and temperature falls in few hours. Recurrence occasionally happens: inject smaller amount. In absence of these drugs, general treatment of fevers, cold sponging, etc. Pain often needs morphia. At crisis, stimulants necessary, especially in old or weakly persons.

PROPHYLAXIS.—Factors promoting spread are similar to typhus: overcrowding and lice. Sterilization of clothes, cleanliness of dwellings, protection from lice.

AFRICAN TICK FEVER.

Closely allied to relapsing fever, but conveyed by a tick.

Spirochæte.—*Sp. duttoni*: first studied fully by Dutton and Todd in East Africa, and by Koch, though previously observed by others. Differs very slightly from *Sp. recurrentis*, but more pathogenic to monkeys and other animals: also slight differences when cultivated by Noguchi's method. Immunity to *Sp. duttoni* does not cause immunity to *Sp. obermeieri*, or vice versa.

Mode of Transmission.—By a tick, *Ornithodoros moubata*, probably not by salivary glands, but by secretion of special coxal glands when feeding. In the body of the tick the spirochæte undergoes morphological changes, forming minute chromatin granules, which are a phase in the life-history and convey the infection (Leishman). Eggs of infected ticks can transmit infection through several generations.

Clinical Course.—Resembles relapsing fever, but pyrexial periods are shorter, two to three days, may be numerous relapses, and spirochætes are more scanty in the blood. Cerebral symptoms, facial paralysis and optic atrophy rarely. No seasonal prevalence.

Mortality.—Low; but arsenobenzol preparations less effective in this type.

CHAPTER XXX.

EPIDEMIC SPIROCHÆTAL JAUNDICE.

(*Spirochælosis Ictero-hæmorrhagica*. *Weil's Disease*.)

An acute condition due to a spirochætal infection, occurring in local epidemics, and characterized by fever, jaundice, enlargement of the liver, hæmorrhages, and frequently a secondary fever.

History.—Epidemics of jaundice long recognized. Described by Matthieu and later by Weil in 1886. Spirochæte discovered by Inada and others in Japan in 1914. Many cases in France during the war. Widely distributed.

NOTE.—The term 'Weil's disease' is now confined to spirochætal jaundice and does not apply to epidemic catarrhal jaundice (q.v.).

The Spirochæte.—*Leptospira ictero-hæmorrhagica*. Length 5 to 25 μ . In stained preparations, 4 to 5 waves; with dark-ground illumination, numerous fine spirals; by special methods, characteristic flagellum with terminal 'knob'.

CULTIVATION.—Feasible in many media, e.g., diluted rabbit's serum with covering of liquid paraffin. Subculture in two to three weeks.

DISTRIBUTION IN HUMAN BODY.—In peripheral blood up to fifth, and rarely ninth, day of disease. Later, excreted in urine. Occurs in liver, suprarenals, and, later, kidneys, but scanty in all human organs. Absent in life from duodenal contents.

Mode of Transmission.—*Reservoir*: Rats (may be apparently healthy). Transmission from urine of infected rats and human beings. Infection through wet or abraded skin: sewer workers liable: bathing in infected pools. Not from man to man.

Morbid Anatomy.—

LIVER.—Enlarged: ordinary changes of catarrhal jaundice: less often necrosis and degeneration, which may be extreme, as in cholæmia and acute yellow atrophy.

DUODENUM AND BILE PASSAGES.—May be slight inflammation, but no proof of obstruction.

LUNGS.—Hæmorrhages, often of considerable size.

SPLEEN.—Enlarged.

KIDNEY.—Often parenchymatous nephritis.

BLOOD.—Fragility of red cells not increased. Platelets diminished.

Epidemic Spirochætal Jaundice, *continued*.**Symptoms.**—

INCUBATION PERIOD.—Five to seven days.

ONSET.—Sudden. Shivering, headache, *marked prostration*, and muscular pains.

EARLY SYMPTOMS.—Temperature 103° to 105° . Pulse rarely exceeds 100. Anorexia. Constipation, rarely diarrhoea. Vomiting. Tongue furred.

JAUNDICE.—Begins on fourth or fifth day; maximum about ninth day.

HÆMORRHAGES.—Rarely absent in severe cases: may be from lungs, stomach, nose, rectum, or as purpura.

HERPES LABIALIS.—Frequent.

LIVER.—Enlarged and tender. Spleen rarely palpable.

BLOOD.—Total leucocytes 20,000 to 30,000. Polynuclear cells 80 to 90 per cent.

URINE.—Bile present for three to four weeks. Albumin and casts common. Acetone only with cholæmia.

PROGRESS.—*Initial fever* falls in ten to fourteen days. Symptoms improve. *Secondary fever* common: in third week, may be 103° , about ten days: no return of symptoms.

SUBSEQUENT COURSE.—Usually uninterrupted. Convalescent in three to five weeks.

ANOMALOUS FORM.—Not uncommon. Similar symptoms, but *jaundice absent*.

Diagnosis.—

CLINICAL.—Suggested by sudden onset, pyrexia, prostration, herpes, and jaundice about fourth day. In enteric, jaundice rare, especially before second week. From catarrhal jaundice, by late onset of jaundice, but often clinically impossible.

PATHOLOGICAL.—By intraperitoneal injection of guinea-pigs.

1. BLOOD.—Spirochætes present until fifth day and rarely to ninth. Direct observation difficult (Burri's Indian ink or Fontana's silver method). *Guinea-pig*: Intraperitoneal injection of 3 to 5 c.c. of patient's blood: incubation period six to thirteen days, then jaundice, collapse, and death in twenty-four hours, may be petechial hæmorrhages: spirochætes present in blood and solid organs, especially liver, also kidneys and suprarenals. Hæmorrhages in lungs and intestinal walls: spleen enlarged: acute parenchymatous nephritis.
2. URINE.—Spirochætes present, not before tenth day, almost invariably present by twentieth day: rare after fortieth day. Centrifugalize urine and examine deposit.

Mortality.—Very low. Death occurs with convulsions and signs of cholæmia.

Treatment.—Antispirochætal serum: 20 c.c. intravenously, given repeatedly. Salvarsan preparations of no effect. Aperients necessary.

CHAPTER XXXI.

SYPHILIS.

A specific infection by the *Spirochæta pallida*,* acquired by contact, commonly sexual intercourse, or transmitted through the mother. The essential lesion is an infective granuloma.

Introduction into Old World from America in 1493 is generally accepted.

Name 'syphilis' appears first in 1530, in a poem by Fracastor; 'Syphilus' was the name of the infected hero.

SCHAUDINN, 1905, discovered the *Spirochæta pallida*.

WASSERMANN, 1908, described the original serum test based on the Bordet-Gengou reaction.

EHRlich, 1910, produced salvarsan as a cure.

The Parasite.—

MORPHOLOGY.—A very delicate organism: often somewhat curved: length 4 to 14 μ , breadth 0.25 μ : numerous fine, sharp, regular corkscrew spirals, commonly eight to twelve in number, persisting during rest and after staining. Flagella stained by special methods, one at each end. Motile but not very active, movements being: (1) Rotary about long axis; (2) Backward and forward movements; (3) Bending movements. Change in position slight. Does not pass a Berkefeld filter.

LIFE HISTORY.—Unknown.

OCCURRENCE IN THE BODY.—*Spirochætes* are extracellular.

PRIMARY LESIONS.—Presence most numerous in primary sore, condylomata, mucous patches.

SECONDARY LESIONS.—In cutaneous eruptions: scanty.

GUMMATA.—Scanty: rarely found.

NERVOUS SYSTEM.—In tabes and general paralysis: very scanty.

CONGENITAL INFECTIONS.—Often extremely numerous in tissues, especially in liver.

Have been found in placenta, umbilical cord, and with difficulty in blood of infected persons.

CULTIVATION.—The parasite has been cultivated by Noguchi, strictly anaerobically, in ascitic fluid and agar containing a piece of sterile rabbit kidney or testis.

TRANSMISSION TO ANIMALS.—In *higher apes*: by scarification and inoculation: subcutaneous inoculation negative. Primary lesion after thirty days: resembles human lesion with induration of glands. Secondary lesions mild: occur in about 50 per cent. No tertiary lesions. Wassermann reaction positive. In *lower monkeys and rabbits*: local sore only. In rabbit's eye, produces iritis and keratitis.

* Correct designation is said to be *Treponema pallidum* or *Spiroplasma pallidum*. Chaudinn's original name *Spirochæta* (or *Spirochæte*) *pallida* is commonly employed.

Syphilis—The Parasite, continued.**METHODS OF OBTAINING SPIROCHÆTES.—**

Chancre.—Wash with normal saline: if painful, swab with 4 per cent eucaine: suck with small Bier's flask, or squeeze with *protected fingers* to obtain deep fluid: transfer fluid to slide with platinum loop.

Glands.—Puncture groin glands with hypodermic needle.

METHODS OF EXAMINATION.—(Oil-immersion lens for all methods.)

1. **BURRI'S INDIAN INK METHOD.**—Fluid from lesion stirred in drop of Indian ink ('Chin chin liquid pearl'), and spread on slide. Examined with artificial light. Spirochæte appears as white shining spiral on black ground.

2. **STAINED FILMS.**—Fluid spread on slide. Best stained with Giemsa's azur-eosin: *Sp. pallida* stains a pinkish violet: does not stain with ordinary dyes.

3. **DARK-GROUND ILLUMINATION.**—Special paraboloid condenser. Morphology and motility of spirochæte well exhibited.

SECTIONS.—Levaditi's silver deposition method. Tissue impregnated with silver nitrate: then reduction by pyrogallie acid deposits silver on the spirochætes: sections cut by microtome.

IDENTIFICATION OF SP. PALLIDA.—Mainly by:—

1. Number (8–12) and regularity of spirals. Parasite very fine.

2. With Giemsa, stains faint pinkish violet. Other spirochætes stain deeper blue.

Sp. refringens, present in ulcerated lesions: (a) Thicker and coarser; (b) Few, irregular, and flatter spirals; (c) Stains deeper and more blue; (d) Greater motility.

Morbid Anatomy.—All syphilitic lesions have in common: (1) Inflammation of connective tissue; (2) Changes in vessels, endarteritis or periarteritis. The picture varies with site of the lesion.

PRIMARY CHANCRE.—Consists of (1) Connective-tissue cells and fibroblasts; (2) Infiltration of small round cells; (3) Epithelioid cells and giant cells (scanty). Small vessels show obliterative endarteritis, causing the surrounding induration.

GUMMA.—An 'infective granuloma'. Consists, in early stage, of cells as above. *Early*: vessels scanty. *Later*: new vessels numerous. Then obliterative endarteritis occurs, followed by caseation of tissue, necrosis, and rupture in certain situations.

Distinction from tubercle difficult. Main points: (1) In gumma, new vessels prominent, in tubercle absent; (2) In gumma, epithelioid and giant cells scanty, and latter less definite than in tubercle.

Modes of Infection.—Conveyed by secretion from syphilitic lesions, especially chancre and early secondaries. But semen may contain spirochætes in absence of lesions of external genitals.

SEXUAL CONNECTION.—Common sites of chancre: *Male*, sides of frenum, glans, sulcus, prepuce; less commonly, within meatus, body of penis, scrotum, etc. *Female*, labia minora, os uteri; occasionally labia majora; vagina rare.

Transmission by connection is unusual more than 5 years from original infection: but there is no time limit to infection of foetus by mother.

ACCIDENTAL INFECTIONS.—*Extragenital chancres.*

In medical practice, e.g., on fingers or back of hands.

Lips: commonest extragenital chancre.

Various sites by accidental infection or in sexual perversion.

CONGENITAL INFECTION.—Intra-uterine infection of foetus through placenta. Mother often has no signs, but Wassermann reaction is positive.

Syphilis thus may be **ACQUIRED** or **CONGENITAL**.

Immunity.—No acquired immunity. No immunity, active or passive, has been effected in animals. Syphilitic subjects are resistant to reinoculation, but after cure are again susceptible. Two laws of last generation state: (1) *Colles's Law*—a syphilitic infant does not infect its own mother; (2) *Profeta's Law*—a mother with syphilitic symptoms may suckle her own infant without infecting it. Explanation is that mother and child respectively are in fact already infected.

ACQUIRED SYPHILIS.

Incubation Period.—Interval between infection and appearance of primary lesion (chancre) usually three to four weeks. Rarely under ten days. To be doubted if under one week or over six (or possibly twelve) weeks. Period often impossible to determine.

Note.—Infection with spirochaetes is generalized within few days of inoculation, certainly before appearance of chancre.

Stages of Syphilis.—Symptoms are referred to three stages, *Primary, Secondary, and Tertiary*. Certain late, nervous lesions are known as quaternary syphilis or parasymphilis.

Primary Stage.

The Chancre.—

Initial lesion of syphilis is the 'primary', 'hard', or 'Hunterian' chancre, a local manifestation which commences as a painless, small, red papule: enlarges to size of pea: ruptures, forming small ulcer.

CHARACTERISTICS.—Raised, edges indurated, may feel like nodule of cartilage, floor often grayish slough, secretion slight, suppuration uncommon. Freely movable.

PROGRESS.—Granulation occurs, and ulcer heals with or without treatment.

SCAR.—May be slight or absent.

USUALLY SINGLE, occasionally two or, rarely, more.

SITE.—See **MODES OF INFECTION**, above.

varieties of Chancre.—On glans induration often absent. A tight prepuce becomes oedematous, chancre palpable below.

In females, often obscured by oedema: frequently unnoticed.

SEPSIS.—With infection by septic organisms or bacillus of soft sore, acute ulceration occurs, very painful: diagnosis obscured.

Syphilis, Primary—Varieties of Chancre, *continued*.

EXTRAGENITAL CHANCRES.—Induration less marked : ulceration greater.

PHAGEDÆNA.—Rare : rapid ulceration, penis may be destroyed.

Lymphatic Glands in area of chancre (e.g., groin) enlarged and 'shotty' : suppuration only with septic infection.

Diagnosis.—Especially from : (1) Traumatic ulceration ; (2) Soft sore ; (3) Herpes of prepuce ; (4) Scabies.

Secondary Stage.

Is a period of manifestations of general infection, a long-drawn fever with constitutional symptoms, as opposed to the localized lesion of the primary stage.

Onset.—Usually five to twelve weeks after chancre.

Duration.—About two years, but no definite limit.

Principal Manifestations.—(1) Rash ; (2) Sore throat ; (3) Mucous patches ; (4) Condylomata ; (5) General enlargement of lymphatic glands ; (6) Loss of hair ; (7) Anæmia ; (8) Fever ; (9) Headache and insomnia not uncommon.

OTHER MANIFESTATIONS.—Bones. Eyes (especially iritis). Acute nephritis. Nails. Acute myelitis. Joints. Testes. Effect on pregnancy.

Secondary lesions possess a general tendency to be symmetrical.

Rash.—

GENERAL CHARACTERISTICS.—

1. **POLYMORPHIC.**—Macules, papules, etc., present simultaneously, yet spots tend to be of similar size : roundish : except roseola, are infiltrated.
2. **ROUGHLY SYMMETRICAL.**—Abundant. On flexor rather than extensor surfaces. Occasionally a few spots only, e.g., on flexor surfaces of forearms.
3. **COLOUR.**—A coppery tint is specially suggestive.
4. **DOES NOT ITCH.**
5. **DISAPPEARS WITHOUT TREATMENT.**
May resemble any known rash, e.g., seborrhœa.

MAIN VARIETIES.—

MACULAR SYPHILIDE, SYPHILITIC ROSEOLA.—Commonest type and earliest onset. *Appears* about six weeks after chancre. *Duration*, three to six weeks. Rose-coloured spots, size about $\frac{2}{8}$ inch ; when well developed, do not disappear on pressure ; no infiltration. On trunk and flexors of arms ; very rare on face. Leaves brownish stain. Recrudescence not uncommon sometimes in late stages.

PAPULAR OR LENTICULAR SYPHILIDE.—Onset tends to be later than previous type. Raised, often coppery, shiny scales at margins, infiltrated. Desquamates. Abundant distribution, includes face. *Duration*, one to three months or longer.

PAPULOPUSTULAR SYPHILIDE.

SQUAMOUS SYPHILIDE (syphilitic psoriasis).—Resembles psoriasis, but less silvery and scaly, infiltrated, and mainly on flexors: development rapid, often coppery tint, fissures common.

RUPIA (crusts form over ulcers). **ECTHYMA** (ulceration of pustules).—These are rare forms developing in neglected pustular eruptions.

DIAGNOSIS.—

PITYRIASIS ROSEA.—Diagnosis from macular syphilide. Itches: covered with fine scales: glands and mucous membranes unaffected. Scaly syphilides are infiltrated and less pink.

LICHEN PLANUS.—Diagnosis from papular syphilide. *Lilac tint*, flat-topped, polygonal, shiny. *Itches*.

PSORIASIS.—Mainly on elbows and knees. Shiny and scaly. Chronic.

DRUG RASHES.

Sore Throat.—Tonsils swollen: *ulcers*, small, gray, clear-cut, shape, (a) kidney or (b) 'snail track', often symmetrical. Entire mucous membrane of mouth and tongue (glossitis) often inflamed: also *larynx* (hoarseness).

Mucous Patches.—Flat gray areas. *Site*: moist regions, especially angles of mouth, and also within mouth, e.g., on tonsils.

Condylomata.—Papules, from hypertrophy of papillæ; moist, round. Very infective; always syphilitic. *Sites*: skin surfaces in apposition, i.e., external genitals, perineum, toes, under breasts. Specially in women.

Lymphatic Glands.—*Generalized slight adenitis*, especially *epitrochlear* and *cervical glands*. Never suppurate.

Alopecia.—Hair loses gloss and falls out: often in patches. Grows again after treatment.

Anæmia.—Very common. About 4,000,000 red cells per c.mm.

Fever.—Usually slight. Very rarely severe.

Other Lesions, less frequent or characteristic.—

BONES.—(1) Wandering ('osteocopic') pains common, mainly at night; (2) Symmetrical subacute periostitis of long bones frequent: effusion results in '*nodes*', e.g., on edges of tibiæ.

EYES.—*Iritis* common, usually in second year: iris muddy, pupil small and reacts sluggishly. Rarely, choroiditis and retinitis.

NAILS.—'Syphilitic onychia': ulceration around and destroying nail: nails brittle.

Occasional Lesions.—

ACUTE NEPHRITIS.—Tends to be very severe. See **RENAL SYPHILIS**, p. 233.

ACUTE MYELITIS.—See **DISEASES OF THE NERVOUS SYSTEM**.

Syphilis, Secondary—Occasional Lesions, *continued*.

JOINTS.—Very rarely affected in acquired syphilis. Subacute painless symmetrical arthritis, usually knees.

TESTIS.—Rarely affected. Epididymitis or orchitis.

Pregnant Woman usually aborts.

Late Secondary Syphilis.—Certain symptoms tend to occur late in the secondary stage, or there may be recurrences of former symptoms. Such manifestations emphasize the fact that the division into stages is not absolute; these symptoms may even occur years after infection.

RASHES.—Any type of secondary rash may occur, especially roseola. Usually less characteristic in late stages. Rupia occasionally.

IRITIS.—Essentially a late secondary manifestation.

SUPERFICIAL GLOSSITIS.

ACUTE MYELITIS.

ORCHITIS.—Painless and symmetrical.

Some of these are variously regarded as late secondary or as tertiary manifestations.

Tertiary Stage.

Onset.—Usually from two to ten years after infection. Occasionally after six months. No absolute upper limit.

Duration.—Unlimited. Recurrences common.

Fever.—May occur, be prolonged, and of any type.

Lesions of Tertiary Syphilis.—Tertiary manifestations result from chronic inflammation of cellular tissue, which may be: (1) *Diffuse*, as in syphilitic cirrhosis of the liver; (2) *Localized*, viz., the *gumma*. Action on the blood-vessels, viz., various forms of arteritis, takes part in all lesions. A classification follows, but the pathological basis is the same throughout, with the gumma as its predominant expression.

i. Gumma.

ii. Cutaneous and mucous-membrane lesions.

iii. Visceral lesions: (1) Nervous. (2) Circulatory: (a) Mesaortitis (aneurysm); (b) Obliterative endarteritis, etc. (3) Liver. (4) Testis. (5) Bones. (6) Alimentary system (rectum). Rare: (7) Respiratory system; (8) Kidneys.

iv. Various lesions: Miscarriages; effect on pregnancy. Amyloid disease.

Gumma.—No tissue or organ immune (except possibly prostate), especially in skin, mucous membrane, subcutaneous tissue, and muscles.

CLINICAL APPEARANCE (e.g., in subcutaneous tissue).—Firm, painless swelling develops rapidly, enlarges, softens, ruptures, discharges contents: ulcer results.

ULCER.—Circular ; deep, wall steep and 'punched-out' ; floor, yellow 'wash-leather slough' ; base infiltrated ; foul discharge common.

TERMINATION.—Varies with site and treatment. Responds rapidly to treatment except in brain.

1. ABSORPTION.—With treatment, if gumma is unruptured, this may be practically complete (e.g., in testis). May be absorbed after fluctuation.

2. ULCERATION, HEALING, AND SCAR.—Thin 'tissue-paper' scar, usually pigmented. Almost, but not quite, pathognomonic of syphilis.

ON BONES.—Hardens, producing osteosclerosis.

RECURRENCES.—Frequent.

SCARRING.—In certain sites may cause serious deformities, e.g., larynx, rectum, and liver.

DIAGNOSIS.—(1) Origin without cause, grows rapidly, softens, ulcer distinctive ; (2) History and signs of previous syphilis ; (3) Wassermann reaction positive ; (4) Yields to antisyphilitic treatment. Spirochaetes can rarely be found.

Cutaneous and Mucous-membrane Lesions.—

NODULAR CUTANEOUS SYPHILIDE (*tertiary or tubercular syphilide, syphilitic lupus*).—Commences as small brownish nodules, which enlarge ; area increases by coalescence with fresh outlying nodules, producing serpiginous syphilide. *Margins* round or roughly crescentic ; diameter 1 inch and upwards. At edges raised nodules. Periphery extends, while in centre healing and scarring occur in various degrees. Skin thickens. *Site* usually single ; especially forehead, neck, back, and scrotum, also palms and soles. Resembles *lupus vulgaris* : distinguished by (1) rapid growth, (2) no apple-jelly nodules.

MULTIPLE CUTANEOUS GUMMATA.—Condition more severe than last : numerous gummatous ulcers.

MUCOUS MEMBRANES.—Gummata common : ulceration very rapid ; destroys all tissues, e.g., nasal cartilage ; heals with much scarring and deformity, whence strictures. *Sites* : nose ; palate (perforations) ; larynx (strictures) ; pharynx ; tongue, often with leucoplakia (*see* SYPHILIS OF THE TONGUE, p. 231).

RARE CUTANEOUS CONDITIONS.—Leucoderma is sometimes syphilitic (or parasyphilitic). Keratoderma of the soles.

Bone Lesions.—

LONG BONES.—Localized gummata. Pain severe, especially at night. Discharge through skin.

BONES AFFECTED.—Clavicle (especially sterno-clavicular joint), sternum, ribs, tibia, femur. Dactylitis rare. No bone immune.

FLAT BONES.—Lesions may be extensive, causing great disfigurement. Now rare.

BONES AFFECTED.—Skull : bones of nose and palate ; frontal and parietal bones (may penetrate skull). Gumma of inner layer of skull may press on brain. Vertebrae rare : may cause retropharyngeal, lumbar, or iliac abscess ; or pressure on cord.

Diffuse osteitis and periostitis not common.

Syphilis, Tertiary, *continued*.

Testis.—Lesion may be:—

1. **DIFFUSE INTERSTITIAL.**—Testis enlarged, smooth, painless. May shrink later.
2. **NODULAR GUMMATA.**—May discharge through skin.

NOTE.—Epididymis, prostate, ovaries: rarely affected.

Visceral Lesions.—See p. 230 and elsewhere.

Amyloid Disease.—Common formerly in chronic syphilis.

Effect on Pregnancy.—See CONGENITAL SYPHILIS, *below*.

Quaternary Stage or Parasyphilis.

Diseases occurring usually many years after infection: (1) Tabes dorsalis; (2) Dementia paralytica. Syphilitic origin established by (a) Accumulated evidence of preceding syphilis; (b) Wassermann reaction; (c) Presence of *Spirochæta pallida* in tissues.

CONGENITAL SYPHILIS.

General Principles.—*Inheritance of syphilis and effects on pregnancy.*

1. **EFFECTS OF SYPHILIS ON PREGNANCY.**—Repeated miscarriages suggest syphilis. The liability diminishes with the interval since infection, and with treatment. Typical results are: (a) *Repeated miscarriages*. (b) Waning effects in successive pregnancies—e.g., sequence in 6 consecutive pregnancies: (i) early abortion; (ii) miscarriage in later months; (iii) syphilitic infant, death in few days; (iv) healthy at birth, syphilis in few weeks (typical 'congenital syphilis'); (v) malnutrition only, possibly interstitial keratitis later; (vi) healthy life.
2. **CONGENITAL SYPHILIS.**—Always inherited from mother, in whom Wassermann reaction is positive even if no symptoms are present; this explains Colles's law (*see* p. 223). Mother may have ceased to be sexually contagious.
3. **CONGENITAL SYPHILITIC CHILD** shows: (1) Wassermann reaction positive; (2) Immunity to acquired syphilis (at least until puberty)—this explains Profeta's law; (3) Response to treatment.
4. **SYPHILITIC FATHER.**—Has syphilitic child only if his lesion can infect the mother.
5. **TRANSMISSION TO THIRD GENERATION** unproved.

Symptoms.—

- A. **PRESENT AT BIRTH**, death occurring within a few days. Emaciated and feeble; bullous eruption on palms and soles; syphilitic pemphigus neonatorum; snuffles; epiphysitis; disease of skull bones; enlarged liver and spleen. Rarely syphilis hæmorrhagica neonatorum.

Syphilitic fœtus has large spleen and liver, teeming with spirochætes, bone changes, and various syphilitic lesions. The placenta shows cirrhosis and arterial changes. Hydramnios common.

B. APPEAR A FEW WEEKS AFTER BIRTH ('congenital syphilis').—Healthy at birth. Symptoms divisible into: (1) Early symptoms. (2) Late symptoms. Both groups suggest long-drawn secondary stage, lesions similarly tending to be symmetrical. (3) Tertiary and parasyphilitic lesions. Any symptom of acquired syphilis may occur.

Early Symptoms.—

WASTING WITHOUT CAUSE. MUDDY COMPLEXION.

'SNUFFLES'.—Onset three to eight weeks. A syphilitic rhinitis, causing: (i) Contagious discharge, whence 'snuffling'; (ii) Necrosis of nasal bones, whence later characteristic depressed bridge of nose.

SKIN AFFECTIONS.—Onset three to twelve weeks. (i) Roseolar rash: napkin area, may ulcerate; (ii) Squamous eruption on palms and soles, thickening with *profuse desquamation*; (iii) Ulceration at angles of mouth ('rhagades'), whence later radiating scars; (iv) Hair loses gloss and falls out, especially *eyebrows*.

ENLARGEMENT OF LIVER AND SPLEEN.—May be jaundice.

BONE AFFECTIONS.—(i) *Syphilitic epiphysitis*: ends of long bones; often symmetrical or multiple. Occurs within first few months. Rapid loss of movement (syphilitic pseudoparalysis). Epiphyses may suppurate or separate. Diagnose from rickets by (a) early age, (b) localization of thickening. (ii) Bossing of frontal prominences of skull. (iii) Craniotabes (not confined to syphilis). (iv) Syphilitic dactylitis: phalanges, metacarpals, metatarsals. From second year onwards. Swelling may rupture. Diagnosis from tuberculosis difficult.

GENERAL GLANDULAR ENLARGEMENT is uncommon.

OCCASIONAL SYMPTOMS.—Iritis, onychia, various rashes, orchitis. Very rarely, hair becomes thick (syphilitic wig).

Progress.—Improves under treatment. Development is slow: may be 'infantilism'.

Late Symptoms.—Onset during second dentition or puberty.

EYE.—*Interstitial keratitis*, bilateral; may cause blindness; cornea steamy (ground glass); duration one to two years. Prognosis good: clears from periphery to centre, where opacities may remain. Commonest late symptom; may be sole syphilitic lesion. *Iritis, disseminated choroiditis*: not uncommon, often with keratitis; prognosis worse, vision permanently affected. Rarely, optic atrophy.

SYNOVITIS (Clutton's Joints).—Painless, symmetrical, with effusion. Usually in *knees*. Synovitis of this type is always syphilitic.

BONES.—Symmetrical periostitis, especially of *tibiae*. Result: inflammatory thickening, mainly in middle, whence '*sabre-shaped curvature*'. Syphilitic dactylitis.

EAR.—Causeless, rapid, permanent, bilateral deafness: probably labyrinthine. Age 11 to 20 years. Females predominate.

Syphilis, Congenital—Late Symptoms, *continued*.

HUTCHINSON'S TEETH.—Upper central *permanent* incisors stunted, peg-shaped, cutting edge smaller than base: edge deeply notched, exposing dentine. Rarely recognizable in adults owing to rapid erosion of cutting edge. Canines may be notched, and first molars domed (Moon's molar).

Tertiary Lesions.—Gummata; not common, but may occur as in acquired syphilis and at any age or site (especially testes).

Parasyphilis.—

'**JUVENILE GENERAL PARALYSIS**'.—Rare. Occurs at about 16 years. *Tabes dorsalis* is considerably rarer. See SYPHILIS OF THE CENTRAL NERVOUS SYSTEM.

Residual Symptoms.—(1) Pallor, malnutrition; (2) Depressed bridge of nose; (3) Radiating scars at angles of mouth; (4) Square or asymmetrical skull; (5) Liver and spleen may be palpable; (6) Wassermann reaction positive; (7) Thickening of tibiae; (8) Corneal opacities; (9) Hutchinson's teeth.

VISCERAL SYPHILIS.

Syphilis of the Lungs.

Very rare. Most important is the fibrosis at the root of the lung, the frequency of which is not yet fully known.

A. Congenital Syphilis.—*White pneumonia of the fœtus*: large areas airless, gray, and smooth (not granular, as in 'gray hepatization'): alveolar walls thickened, filled with desquamated cells: numerous *Spirochæta pallida*. Pathological interest only: life not exceeding few hours.

B. Acquired Syphilis.—

1. **INTERSTITIAL PNEUMONIA** (fibrosis) at the root of the lung: fibrosis spreads outwards along bronchi and vessels. May be associated with gummata and with bronchiectasis. Characters: (i) Symptoms in general resemble pulmonary tuberculosis, tubercle bacilli absent; (ii) Changes mainly at root of lungs, noticeable in radiograph; (iii) Improves with antisyphilitic treatment; (iv) Syphilitic history and other lesions may be present; (v) Wassermann reaction positive. No spirochætes in sputum.

2. **GUMMATA.**—Very rare. Usually numerous and encapsuled: may be caseous and bronchiectatic cavities.

Syphilis of the Bronchi.

SECONDARY.—May be hyperæmia, causing cough ('syphilitic bronchitis').

TERTIARY.—Gummata in or near large bronchus: tend to fibrose, producing bronchial stenosis or bronchiectasis. Invasion of lung rare.

Syphilis of the Tongue.

Lesions frequent; some characteristic. Carcinoma may follow.

PRIMARY: CHANCER.—

SITE.—Usually near tip on dorsum. Indurated. Ulceration may be deep.

DIAGNOSIS.—(a) Epithelioma, at sides of tongue, painful. (b) Tuberculous ulcer, painful, pulmonary disease advanced.

SECONDARY.—Shallow ulcers.

TERTIARY.—

LEUCOPLAKIA.—Mucous membrane thickened and white, especially in smokers. Proof of syphilis not invariable. Carcinoma may follow.

SYPHILITIC GLOSSITIS.—Diffuse gummatous infiltration: results in *deep fissures*, large hard tongue, leucoplakia common. Very characteristic. Carcinoma may follow.

LOCALIZED GUMMATA.—Infrequent.

Syphilis of the Pharynx.

Lesions frequent.

PRIMARY: CHANCER.—Uncommon. Usually tonsil. Induration slight.

SECONDARY.—

1. **ERYTHEMA.**—Dusky red rash. Palate or tonsil. Diffuse or localized.

2. **MUCOUS PATCHES.**—On tonsils, pillars, or soft palate: produce 'snail-track' ulcers: often symmetrical. Often late secondary stage. Symptoms slight.

TERTIARY.—Gummatous ulceration, often rapid and extensive. Frequent sites: posterior pharyngeal wall; posterior wall of soft palate. Dysphagia usual. Perforation of soft palate common; also adhesions of soft palate to posterior wall.

Syphilis of the Liver.

(*Syphilitic Hepatitis.*)

A. Congenital Syphilis.—

1. **DIFFUSE HEPATITIS.**—Occurs in infants born with disease, or developing signs within a few weeks. Present in most early fatal cases.

MACROSCOPIC.—Liver large and tough, of yellow or flinty colour.

HISTOLOGY.—Pericellular cirrhosis. Spirochaetes in enormous numbers. (In early stages in foetus, a diffuse, small round-cell infiltration.)

PHYSICAL SIGNS.—Liver enlarged, below navel. Spleen also enlarged. Ascites rare. May be jaundice.

2. **LATER CONGENITAL SYPHILIS.**—Liver changes similar to acquired forms. Jaundice not common.

Syphilis of the Liver, *continued*.

B. Acquired Syphilis.—

SECONDARY.—Jaundice occasionally: probably catarrh of ducts. *Very rarely*, acute hepatitis (*see below*).

TERTIARY.—Lesions important. (1) Gummata; (2) Scarring of liver. May coexist.

GUMMATA.—*Size*: from a pea to a fist or larger. Often multiple. *Site*: any part, most commonly anterior surface, junction of right and left lobes. *Appearance*: firm, grayish, roughly spherical. Three zones present in early gummata, especially when large: (i) Caseous centre; (ii) A surrounding fibrous-tissue zone; (iii) Outer zone of small round-cell infiltration, where condition is advancing. *Progress*: caseation; then absorption partial or complete, resulting in *scarring*. Rarely softening or calcification. Local peritonitis may occur.

SCARRING OF LIVER.—Depressed scars on surface of liver: fibrous-tissue strands run inwards; may be gummatous or caseating areas. Scarring of all degrees from small superficial linear scars up to extreme deformities (botryoid liver).

AMYLOID DISEASE.—Now rare. Other organs also affected.

SYMPTOMS.—Three principal groups:—

- i. TUMOUR OF THE LIVER (*gumma*).—Palpable mass: liver usually large and tender. Pain in right hypochondrium-epigastrium common. *Spleen* may be palpable. Offer other syphilitic signs. *Diagnosis* from neoplasm difficult. *Wassermann reaction* positive. Antisyphilitic treatment effective. Jaundice rare.
- ii. RESEMBLES ATROPHIC CIRRHOSIS OF LIVER (*scarring*).—Fever and ascites: may be jaundice. Liver edge irregular, if palpable. Portal obstruction probably mechanical from gumma or scarring in the portal fissure. May be no syphilitic signs. *Hæmatemesis* unusual.
- iii. WITH ENLARGEMENT OF SPLEEN.—May simulate splenic anæmia, Banti's and Hanot's disease, acholuric jaundice, and many conditions with splenomegaly.

Occasionally condition resembles hypertrophic cirrhosis of the liver, Banti's disease, splenic anæmia. Rarely, symptoms suggest suppuration.

C. Acute Hepatitis.—Most often with arsenical treatment: rarely occurs in secondary syphilis untreated. Three degrees: (1) Mild: jaundice for few days. (2) Fatal: progresses to acute necrosis as in yellow atrophy. (3) Intermediate: jaundice, constitutional disturbances, liver enlarged.

TREATMENT.—Rest. No syphilitic treatment. Sodium thio-sulphate.

Syphilis of the Alimentary Tract.

Syphilitic lesions are very rare between pharynx and rectum.

STOMACH.—Syphilitic lesions very rare at autopsy. The occurrence of a syphilitic gastritis and gastric ulcer is improbable.

INTESTINES.—Lesions very rare. Stenosis has resulted from gummata.

SYPHILIS OF RECTUM.—Not uncommon: almost invariably women; probably direct infection from vulva and neighbourhood. A slow gummatous growth immediately above internal sphincter; usually surrounds rectum.

Stricture of rectum subsequently develops: may be extreme; distinguished from neoplasm by hard fibrous ring.

SPLEEN.—Enlargement not uncommon. Gummata and scarring not infrequent; liver usually involved also (*see p. 232*).

Syphilis of the Circulatory System.

THE HEART.—The principal effects on the heart are due to syphilitic lesions of the coronary arteries and blood-vessels, resulting in fibroid myocarditis, and to syphilitic lesions of the aorta, resulting in aortic valvular disease.

Gummata are very rare, but some recorded cases are of special interest owing to their position in the bundle of His and functional tissues of auricle and ventricle, producing disturbances of cardiac rhythm and Stokes-Adams' syndrome.

THE ARTERIES.—*See* ARTERIOSCLEROSIS and ANEURYSM.

Renal Syphilis.

A. Secondary Syphilis.—

MILD SIMPLE ALBUMINURIA.—Not uncommon. Prognosis good. Formerly ascribed to mercury, erroneously.

ACUTE SYPHILITIC NEPHRITIS.—Identical with nephrosis.

FREQUENCY.—About 4 per cent.

ONSET.—Commonest two to four months after chancre, viz., at time of rash.

B. Tertiary Syphilis.—Little importance.

1. Amyloid disease.

2. Gummata of the kidneys: very rare. Undiagnosable.

3. Interstitial nephritis. Only with arterial disease.

Syphilis of the Nervous System.

See DISEASES OF THE NERVOUS SYSTEM.

DIAGNOSIS OF SYPHILIS.

General Diagnosis.—Lesions often distinctive and simplified by multiplicity. History and signs of earlier disease often present, viz.:—

PRIMARY CHANCRE.—Scar may be present. Difficulties due to: absence of scar, urethral and extragenital chancres, masking by gonorrhoea or soft sore; in females, presence on os uteri.

SECONDARY LESIONS.—Inquire and examine for these.

TERTIARY LESIONS.—Examine for results of gummata, e.g., 'pigmented tissue-paper' scars on legs, perforations of palate, etc.

Syphilis—Diagnosis, continued.

IN WOMEN.—Repeated miscarriages.

CONGENITAL SYPHILIS.—Residual phenomena (*see* p. 230), especially depressed nose, radiating scars from mouth, history of interstitial keratitis and blindness at puberty.

Specific Diagnosis.—

SPIROCHÆTA PALLIDA.—In chancres, condylomata, and mucous patches. For methods, *see* under 'Parasite', p. 222.

SERUM TESTS.

CEREBROSPINAL FLUID.

Serum Tests.—

1. WASSERMANN REACTION (W. R.).—Original technique must be used.
2. FLOCCULATION TESTS.—Several varieties extensively tried, especially Kahn and Sachs-Georgi: both are very specific and probably more sensitive than W. R., but most observers prefer to use two tests, one to be W. R.

Wassermann Reaction of Serum.—

POSITIVE REACTION.—*Is proof of syphilis*, except that it also occurs in certain diseases—leprosy, yaws, trypanosomiasis, relapsing fever. Transitorily positive in certain acute specific fevers, e.g., glandular fever.

Note.—A positive reaction does not prove that a given lesion, e.g., tumour of liver, is necessarily syphilitic.

NEGATIVE REACTION.—Value depends on such circumstances as lesion—e.g., chancre—treatment, etc. In absence of knowledge of treatment, does not negative syphilis.

DOUBTFUL REACTION.—Such as 'weak positive'. Value only assessable with knowledge of all circumstances of case. Often occurs with patients under treatment (may be concealed).

'Provocative' injection of arsenobenzol preparation may convert negative into positive reaction; test about fifth day. Useful in cases under treatment.

Wassermann Reaction of Serum at Various Stages.—

PRIMARY STAGE (chancre).—Reaction becomes positive four to eight weeks after infection, viz., later than onset of chancre: hence negative reaction does not exclude. But if negative at two months, without treatment, it excludes syphilis.

SECONDARY STAGE.—Practically always positive.

TERTIARY STAGE.—Practically always positive, and remains while symptoms active; in aneurysm always positive. With small lesions, many years after infection, is negative occasionally.

CONGENITAL SYPHILIS.—In absence of symptoms, reaction unreliable in first weeks of life: positive reaction at birth (i.e., mother syphilitic) may become permanently negative and no symptoms; negative reaction at birth may become positive and

symptoms develop. With symptoms, reaction positive in 95 per cent : resistant to treatment and usually positive until puberty.

Noguchi's Intradermal Luetin Test.—Not reliable. May be positive in non-syphilitic cases.

LATENT SYPHILIS.—Previous syphilis but no symptoms: positive in 30 to 40 per cent. Mothers of syphilitic children but without symptoms: usually positive.

SYPHILIS OF NERVOUS SYSTEM.—Positive in 80-90 per cent.

PARASYPHILIS.—*Dementia paralytica*: always positive (also cerebrospinal fluid). *Tabes dorsalis*: positive in 70 per cent.

Cerebrospinal Fluid.—In lesions of nervous system, examine cerebrospinal fluid for: (1) Cells; (2) Globulin; (3) Wassermann reaction; (4) Lange's colloidal gold reaction. In neurosyphilis:—

CELLS.—Small lymphocytes present. Over 10 cells per c.mm. is pathological. This is diagnostic in chronic conditions, but also occurs in tuberculous meningitis, and to some extent in acute poliomyelitis, encephalitis lethargica, and in certain stages of cerebrospinal meningitis.

GLOBULIN.—In syphilis often excessive.

WASSERMANN REACTION.—*Tertiary syphilis*, may be positive or negative; *dementia paralytica*, always positive: *tabes dorsalis*, positive in 70 to 90 per cent.

LANGE'S COLLOIDAL GOLD REACTION.—High globulin content causes precipitation of colloidal gold from suspension. Response in Lange's test may be:—

1. Paretic: 55554331000. In general paralysis.
 2. Luetic: 00243110000. In tabes and cerebrospinal syphilis.
 3. Meningitic: 00001344300. Occurs in various forms of meningitis: not specific.
- Disseminated sclerosis may give paretic or luetic response.

TREATMENT OF SYPHILIS.

Treatment must be commenced immediately, but not before diagnosis is established by unmistakable signs, or by presence of *Spirochæta pallida* or positive serum reaction.

Drugs in Use in Treatment.—

1. ARSENICAL PREPARATIONS.—

i. **ARSENOBENZOL** (arsphenamine).—Original '606' (salvarsan) of Ehrlich. Probably most powerful spirochæticide, but now superseded owing to difficulties in administration. Injections always intravenous.

ii. **NEO-ARSENOBENZOL.**—Ehrlich's '914'. Superseded '606' owing to ease of administration. Soluble in small quantities of water. Injections intravenous. Numerous preparations. *Sulpharsphenamine*: intramuscular injection; pain slight. *Silver salvarsan*: good results.

2. **BISMUTH.**—Many preparations. Probably not quite so effective as arsenical preparations, but has great advantage of allowing

Syphilis—Treatment—Drugs in Use, *continued*.

intramuscular or deep subcutaneous injection with ease and safety.

3. **POTASSIUM IODIDE.**—For promoting absorption of granulomata, gummata, and visceral lesions. No spirochaeticidal powers.
4. **MERCURY.**—Now little used, except when injections impracticable, and in initial stage of treatment of syphilis of nervous system. Administered by inunction, orally, or by intramuscular injections.

Mercury must not be relied upon solely in treatment of syphilis.

Standard Course of Treatment.—**DRUGS AND DOSAGE.—**

1. '914'.—Ten weekly injections (intravenous). Dose: 0.45 gm. rising to 0.75 gm. Total 6 gm.
2. **BISMUTH.**—Ten weekly injections (intramuscular). Dose: 0.3 or 0.4 gm. Total 3 or 4 gm.

STANDARD COURSES.—

PRIMARY SYPHILIS WITH NEGATIVE WASSERMANN REACTION.—Two courses, 2 months interval. In interval give iodide.

PRIMARY SYPHILIS WITH POSITIVE WASSERMANN REACTION.—Give at least a third course: further courses if Wassermann reaction not negative at end of first course.

SECONDARY SYPHILIS.—As last.

TERTIARY SYPHILIS.—Courses as above: number of courses depends on clinical condition and Wassermann reactions. Iodides given from commencement. For visceral and nervous system involvements, commence with smaller doses of '914', and complete total dose by giving two injections weekly.

Chancre.—Rub with 30 per cent calomel ointment.

Wassermann Reactions during Treatment.—Positive W. R. implies activity of spirochaetes. Conversion to negative indicates cessation of activity but is not proof of complete destruction of spirochaetes, and relapse to positive may occur.

Test reaction at end of each course. If positive, further treatment necessary. If negative, repeat at intervals of three months for a year, and then at intervals of six months until cure may be assumed.

Chancre with negative W. R.: If reaction remains negative for one year, cure may be assumed.

If a reaction initially positive becomes *persistently negative* for two years, cure may be assumed. Greatest difficulty is with cases in which W. R. has already relapsed from negative: may relapse again fully up to two years.

'Provocative' injections of '914' will sometimes convert a negative to positive, and may be used as final test.

Indications for Caution in Treatment (commence with small dose, or mercury).—Advanced visceral disease: *renal* (except when syphilitic), hepatic, myocarditis, arteriosclerosis, aneurysm, aortic

disease, diabetes, alcoholism, and disease of *central nervous system*. Old age and infancy. Dementia paralytica is definite contra-indication. In pregnancy with care. Hæmophilia is a contra-indication.

Complications following Arsenical Injections.—None common. May be :—

SYNCOPE.—During injection. Psychical. No importance.

PYREXIA, RIGORS, HEADACHE.—Within few hours.

'NITRITOIDISM'—'ANAPHYLACTOID CRISES'.—Flushing of face, rapid pulse, dilated pupils. If severe, swelling of face, unconsciousness, twitching of limbs. Are vasomotor phenomena and not of anaphylactic origin. Give injection intramuscularly, 5 min. of 1-1000 adrenalin hydrochloride.

SKIN ERUPTIONS.—*Urticaria*, especially after nitritoidism. *Erythema*, very rarely progresses to exfoliative dermatitis. Give intravenous injections of sodium thiosulphate.

VOMITING AND DIARRHŒA.—Rarely severe.

JARISCH-HERXHEIMER REACTION.—The administration of any powerful syphilitic remedy may cause transient exacerbation of symptoms, ascribed to destruction of spirochætes and release of toxins. Well seen in skin and mucous membrane lesions. Also Wassermann reaction becomes more positive.

CRANIAL NERVE PARALYSIS.—Usually 7th or 8th nerve. Rare. From *over-small dose*. Repeat dose. Prognosis good.

SEVERE CEREBRAL SYMPTOMS.—Convulsions, coma, etc. The cause of most fatalities. Very rare. Employ venesection.

JAUNDICE.—Serious if severe. May, very rarely, progress to acute yellow atrophy. Glucose, 50 gm., before injections is precaution. May develop weeks or months after last injection. Treat with sodium thiosulphate.

NEPHRITIS.

Complications following Bismuth Injections.—Intolerance shown early by slate-blue line on gums: later stomatitis and nephritis. Otherwise toxic symptoms rare. Embolism results from injection into a vein.

CHAPTER XXXII.

YAWS.

(*Frambæsia*.)

A contagious inoculable disease characterized by raspberry-like granulomata, caused by *Spirochæta pertenuis* (*Spironema pertenuis*).

Distribution.—Widespread in tropics. Children most often.

Relation to Syphilis.—*Sp. pertenuis* indistinguishable morphologically from *Sp. pallida*. General clinical resemblance, especially in late stages. Wassermann reaction positive early and persistently. But note: (1) Never hereditary; (2) Primary lesion

Yaws—Relation to Syphilis, *continued*.

extra-genital, and infection not conveyed sexually; (3) Primary lesion is distinctive; (4) No visceral or central nervous system lesions; (5) Mucous membranes in general not affected; (6) Mothers are often inoculated from children. Opinion is increasing that conditions are identical.

Incubation Period.—Two to four weeks.

Symptoms.—Often described as having primary, secondary, and tertiary stages (but must not be correlated too closely with stages of syphilis).

PRIMARY LESION.—Papule forms: gradually enlarges, forming granuloma or an ulcer (as in secondary eruption). Constitutes 'mother yaw': nature often overlooked: may heal or persist for months. Site: Lower extremities commonly: any site where skin is broken: genitals rare: in children often on face. Constitutional disturbances moderate: fever and joint pains.

SECONDARY ERUPTION.—Two to four months after primary lesion. Skin loses gloss, and patches of furfuraceous desquamation form. Multiple papules appear in these areas: any site, but mucous membranes are little affected except by auto-inoculation. Papules, often in clusters, enlarge and coalesce: skin desquamates, leaving reddish surface resembling raspberry, the 'yaws nodule'; is teeming with spirochaetes. Grows for two weeks, then stationary several weeks, projecting up to half an inch. Then shrinks: crust forms from secretion, and forms scab. Finally drops off, leaving leucodermic patch of skin.

Successive crops of nodules appear, with fever and rheumatic pains.

DURATION OF ATTACK OF YAWS.—Usually few weeks or months to a year or more.

FOOT YAWS.—Papules on feet, often painful owing to thick epidermis: may ulcerate and form cracks with long duration.

TERTIARY STAGE.—In small proportion only (untreated). Nodules ulcerate instead of becoming absorbed: may last for years. Periostitis, osteitis, and epiphysitis may occur—painful swellings leaving firm nodes on subsiding.

LESIONS ALSO CONSIDERED TO BE TERTIARY YAWS:—

1. *Gangosa.*—Commences as ulcer on soft palate; slowly progresses to extensive destruction.
2. *Juxta-articular Nodules.*—Fibrotic tumours on long bones near joints.

Mortality.—Negligible. General health little affected.

Treatment.—Arsenobenzol, arsphenamine: specific and rapid cure: three injections sufficient. Relapses rare. Sodium hydrogen bismuth tartrate also effective. Mercury useless.

CHAPTER XXXIII.

RAT-BITE FEVER.

A relapsing febrile disease, due to *Spirillum minus*, transmitted to man by bites of infected rats, and characterized by fever, lymphangitis, eruption, and tendency to relapses.

Etiology.—Widespread. *Sp. minus* is a short, fat spirillum. One attack protects.

Symptoms.—Bite may heal normally.

INCUBATION PERIOD.—Variable, usually two to six weeks.

ONSET.—Pain at site of bite, scar breaks down : becomes an ulcer with surrounding inflammation and vesicles.

COURSE.—Acute lymphangitis from site of bite, and lymphatic glands enlarge. After further interval, patient suddenly becomes acutely ill :—

TEMPERATURE RISES to 103° : rigors, vomiting, general pains.

RASH appears : raised erythema or purplish papules : on face, trunk, and limbs ; slowly fades.

TEMPERATURE FALLS in three or four days : often crisis with sweating : symptoms improve.

RELAPSE.—Interval, 3 to 6 days (variable). Temperature rises again, with return of lymphangitis, glandular enlargement, and rash. Relapses last one or two days.

Relapses may recur for weeks or months in absence of treatment.

BLOOD.—Polynuclear leucocytosis : eosinophilia recorded, but unusual.

Suppuration does not occur. Spleen rarely palpable. Spirillum in blood during pyrexia only.

Mortality.—Low. No fatal case in Great Britain.

Diagnosis.—From relapsing fevers. Wassermann reaction negative.

Treatment.—Arsenobenzol : specific cure : several weekly injections necessary. Rat bites should be cauterized.

Section I.—Specific Infectious Diseases, continued.

F. INFECTIOUS DISEASES OF UNKNOWN OR DOUBTFUL ETIOLOGY.

CHAPTER XXXIV.

LYMPHOGRANULOMA INGUINALE.

(Tropical or Climatic Bubo.)

A venereal disease characterized by inflammatory enlargement of the lymphatic glands draining the genitalia, resulting in males in inguinal bubo and in females in a tendency to stricture of the rectum.

Etiology.—

DISTRIBUTION.—Originally recognized on coasts in the tropics. Cases have occurred lately in many countries.

ORGANISM.—Filterable virus. Communicable to guinea-pigs by subcutaneous and to monkeys by subdural inoculation with sterile pus.

Morbid Anatomy.—Lymphatic glands show changes of granuloma.

Incubation Period.—Probably a few days to three weeks.

Primary Lesion.—In males: herpetiform ulcers on penis. In females: rarely found.

Glandular Enlargement.—The glands affected are those draining the genitalia, and differ in males and females.

MALES.—*Inguinal glands* involved: draining ano-genital region.

Enlarge insidiously: commences two to three weeks after primary lesion. Periadenitis follows; glands fuse to skin, which becomes reddish-violet. Multiple areas of softening appear, suppurate, and produce multiple fistulæ. May heal in few months or longer. *Iliac glands* may enlarge, but never suppurate.

FEMALES.—The deeper pelvic glands and those around lower part of rectum are affected. *Sequelæ*: Stricture of rectum in lowest few inches; with or without elephantiasis and ulceration of external genitalia.

General Symptoms.—Fever of several weeks, lassitude, malaise. Occasionally: skin eruptions (erythemata), general glandular enlargement, arthritis.

Diagnosis.—From gonorrhœa, syphilis, chancroid, and from other tropical buboes—e.g., plague, tularæmia.

FREI'S INTRADERMAL TEST.—Pus from a bubo sterilized at 60° C., dilution 1-10. Inject 0.1 c.c. intradermally. Positive reaction is reddish papule in forty-eight hours. Specific.

WASSERMANN REACTION negative (may be positive transiently in acute stages).

Treatment.—Intravenous injection of tartar emetic. Excision or aspiration often followed by secondary infection.

CHAPTER XXXV.

YELLOW FEVER.

An infectious disease due to an unknown virus, transmitted by the mosquito *Aedes aegypti*, and characterized by jaundice, albuminuria, hæmorrhages, especially from the stomach ('black vomit'), and slow pulse with a rising temperature.

Aedes aegypti ('tiger mosquito') was formerly known as *Stegomyia fasciata* or *calopus* and *Aedes argenteus*.

Geographical Distribution.—Known for centuries to be endemic and epidemic in West Africa, West Indies, and Atlantic coast south of New York to Rio de Janeiro. Occasionally imported into Europe, but no epidemics. Ships were specially liable to epidemics (from conveyance of mosquitoes and length of incubation). *Aedes aegypti* usually keeps to low altitudes with warmth and moisture, i.e., near sea coast and big rivers and thus determines general distribution. Modern animal 'protection tests' reveal wide belt in Africa from West Coast to South Sudan: also 'jungle yellow fever' in South America. *Aedes aegypti* is prevalent in Egypt and India, but there is no source of infection. Air routes are inspected to prevent introduction.

Mode of Transmission.—Principal factors:—

1. *Aedes aegypti* conveys infection by bite after feeding on blood of infected persons. Mosquito remains infective throughout life, about five months. Yellow fever in places free of mosquito cannot spread infection. *Note*: Certain other mosquitoes are possibly vectors, but apparently not important.
2. An infected mosquito cannot convey infection until an interval usually of about twelve days (at high temperatures may be less): virus possibly passes through some developmental stage.
3. Young mosquitoes, which only feed by day, are rarely infected. Old mosquitoes feed in evening and early morning and never in middle of the day, at which time risk of infection is negligible. Eggs are laid in water, but are resistant to drying. No hereditary transmission of infection.
4. Blood of infected persons becomes infective in incubation period and ceases after first three days of illness—due to development of immune body. Infection conveyed by subcutaneous inoculation of 1 c.c. or less of blood.

Yellow Fever—Mode of Transmission, continued.

5. The fomites and clothes of infected persons never contain virus.
6. Immunity after attack persists throughout life: due to immune bodies in blood. Relative immunity of those born and living in endemic areas is due to mild unnoticed attacks.
7. Jungle yellow fever: Recorded in central South America, distant from human infection: monkeys are reservoirs of infection: no *Aedes ægypti*, but other *Aedes* species.
8. Epidemics. Commence about two weeks after primary case, i.e., twelve days for development in mosquito, and two days in man. Epidemics cease in cold weather; frequent in late summer.
9. Virus. Unknown: filterable. Present in blood, liver, and other organs. (Spirochæte described by Noguchi, 1919, was from Weil's disease.)

Transmission to Animals: Protection Tests.—

MOUSE.—Is infected by intracerebral inoculations of infected blood: dies of encephalitis. After several passages through brain, virus becomes fixed as 'neurotropic', causing encephalitis in monkeys and not 'viscerotropic' symptoms.

'**MOUSE PROTECTION TEST**'.—For diagnosis of recovered cases of yellow fever. Mixture of patient's serum and infected mouse brain, i.e., 'neurotropic virus', injected intraperitoneally into mice and starch injected intracerebrally to localize virus: if serum is not protective mice die of encephalitis. Test specific and reliable.

MONKEY.—Rhesus monkeys susceptible: symptoms resemble those in man.

'**MONKEY PROTECTION TEST**'.—Mixture of patient's serum and 'viscerotropic' virus injected into rhesus monkey. Test specific: agrees with results of mouse test.

HORSE.—No symptoms after infection, but immune bodies in serum.

Morbid Anatomy.—Cutaneous and visceral hæmorrhages; stomach contains black blood; blood in vessels clotted.

LIVER.—Changes usually sufficient for diagnosis: (1) Lobules infiltrated with mononuclear cells; (2) In mid-zonal region of lobules (less at periphery) cell changes are: (a) hyaline degeneration of cytoplasm, acidophilic; (b) acidophilic intranuclear inclusion bodies in some cells; (c) cells round and separate.

KIDNEYS.—Hæmorrhagic foci; fatty degeneration, cloudy swelling, and changes of acute nephritis.

SPLEEN.—Slightly enlarged.

Clinical Types.—

MILD OR LARVAL.—Previously recognized only in epidemics, but now by serum tests. Symptoms as in onset only: few days' pyrexia: jaundice may be absent; mistaken for malaria, etc.

SEVERE.—As described below.

MALIGNANT.—Death in rapid toxæmia: symptoms slight.

Duration of Infectivity.—Not exceeding four days from onset of symptoms.

Quarantine Period.—Six days. None for 'immunes' (previous attack).

Symptoms.—

INCUBATION PERIOD.—Three to four days. Experimental limits, about ten days.

ONSET.—*Sudden*, with rigor, often in early morning. Usual early symptoms: severe headache, often frontal, pains in back, rapid pyrexia, skin dry. Three stages are often distinctly marked.

STAGE 1.—*Initial Fever.* Duration one to three days. Temperature high from onset, 100° to 106° ; remains steady or rises. Three important symptoms are:—

a. *Facies*: face flushed, eyes red and injected, with definite icteroid tinge.

b. *Pulse-rate* at first rapid; commences to fall with steady or with rising temperature; may continue to do so in following stages (Faget's sign).

c. *Albuminuria* on third day. Urine scanty.

Other symptoms:—

Vomiting: first of food, then of acid and blood towards end of period. *Constipation*. Headache. Epigastric pains. *Pains* in body and limbs of varying severity; may be intense. *Tongue* remains clean at edges, but white fur forms on dorsum. *Jaundice* of skin usually commences at end of stage.

STAGE 2.—*Stage of Calm or Remission.* Duration one to three days. Change from previous stage rapid. Temperature falls nearly to normal, pulse slows further, and symptoms diminish. In mild cases convalescence may now set in. Rarely, anuria and black vomit occur: death then almost invariable.

Serious cases more frequently pass into next stage.

STAGE 3.—*Stage of Reaction or Secondary Fever.* Onset about fifth day. Duration a week or more. This is the critical period. (i) Temperature rises gradually to 104° . (ii) Pulse-rate continues to fall. (iii) *Jaundice intense*. (iv) Vomiting recurs ('black vomit'). (v) Urine diminishes, albuminuria increases. Abdominal pains and melæna. Prostration and weakness extreme.

In favourable cases symptoms commence to subside gradually about eight days from onset.

In unfavourable cases: (i) Vomiting and jaundice increase; or (ii) Suppression of urine occurs, with delirium, uræmic convulsions, coma, and death. Groups (i) and (ii) often occur together.

Summary of Symptoms.—

JAUNDICE.—Icteroid tint in conjunctivæ at onset. Jaundice becomes extreme.

TEMPERATURE.—(1) In first stage high from onset, usually 103° to 105° ; steady or rises. (2) In second stage falls to 98° to 100° . (3) In third stage rises to 101° to 103° ; in favourable

Yellow Fever—Summary of Symptoms, *continued*.

cases after about three days commences to fall by lysis, but in unfavourable cases usually rises continuously until death.

PULSE-RATE.—On first day 100 to 110, then falls to about 75 at end of first stage. Subsequently falls lower, to about 50. *The falling pulse-rate with steady or rising temperature is characteristic (Faget's sign).*

URINE.—Onset of albuminuria usually on third day, even in mild cases. In second stage may be absent. In third stage as in severe acute nephritis; anuria frequent. Hæmoglobinuria rarely.

VOMITING.—In first stage, nausea and vomiting of food, acid, and blood. In third stage, 'black vomit', black fluid containing blood pigment. Amount very large. Emesis with effort.

SPLEEN.—Not enlarged except with malaria.

CONSTIPATION.—Stools not clay-coloured until late. May be 'tarry' from blood.

MENTAL CONDITION.—May remain clear. Delirium in severe cases.

HÆMORRHAGES.—Skin and mucous membranes.

BLOOD.—No characteristic change. Bile present; may be free hæmoglobin.

Progress.—*Relapses* are uncommon. *Sequelæ* are rare: occasional boils or diarrhœa. *Convalescence* usually surprisingly rapid, and strength returns quickly.

MORTALITY.—In white patients under good conditions should not be more than 10 to 15 per cent. High mortality among alcoholics and debilitated subjects.

Diagnosis.—Mild cases resemble catarrhal jaundice, malaria, or simple pyrexias: diagnosis in convalescence by 'protection tests'. In fatal cases, diagnosis by liver changes. In epidemics simple. Important clinical symptoms: (1) Increasing jaundice; (2) Falling pulse with steady or rising temperature; (3) Albuminuria; (4) Black vomit. Diagnosis from:—

BLACKWATER FEVER.—No headache, no falling pulse, hæmoglobinuria constant, hæmatemesis very rare.

MALARIA.—Protozoa in blood; enlarged spleen.

DENGUE.—Difficulty occasionally caused by coexistence.

RELAPSING FEVER.—*Sp. obermeieri* present in blood; enlarged spleen.

SPIROCHÆTAL JAUNDICE.—By laboratory tests.

Prophylaxis.—By anti-mosquito methods, as in malaria.

PROPHYLACTIC INOCULATION.—Injection of mixture neurotropic virus (inoculated mouse brain) and immune serum. Immune bodies develop in serum; duration about two years. Immune serum obtained from convalescents or horses.

Treatment.—No specific remedy. General treatment as in typhoid fever. Fluids and alkalis as in blackwater fever.

CHAPTER XXXVI.

SMALL-POX.

(Variola.)

An acute infectious disease characterized by an eruption which passes through successive stages of papule, vesicle, pustule, and crust, with subsequent scarring.

Recorded from prehistoric times in the Far East. Spread in Europe probably in 6th century A.D.; first described by Rhazes in 10th century; described by John of Gaddesden in 14th century, and studied carefully by Sydenham.

Introduced into America in 16th century.

EPIDEMICS OF 'MILD' AND 'SEVERE' SMALL-POX.—Epidemics have occurred in recent years characterized by persistent mildness of great majority of cases and by trifling mortality of all cases, mild or severe: generally known as 'mild' small-pox. Thus epidemics of 'small-pox' are of two types, the one being the traditional type, the other of low severity, perhaps originating in Africa. These may exist side by side, but most epidemics can be finally allotted to one or other type. The type of low severity is separately described under the title of ALASTRIM OR VARIOLA MINOR (p. 252), and the problems arising are discussed there. The remainder of this section applies to the traditional form ('severe' small-pox), which throughout is referred to as 'small-pox'.

Etiology.—*Susceptibility* almost but not quite universal. Extremely contagious: almost invariably contracted by unvaccinated persons on first exposure to infection. *One attack* does not always protect for life, but second attacks are very rare.

AGE.—All ages equally susceptible, but mortality very high in young children.

SEX.—Equal in males and females.

RACE.—Negroes especially susceptible.

CLIMATE AND SEASON.—Of little influence; more prevalent in tropics. In temperate regions, more frequent in winter than summer.

Epidemics vary greatly in severity: some recent ones very mild.

Morbid Anatomy.—*Pustules* present on skin, tongue, and palate, often on larynx: may extend to stomach: none on trachea, but may be ulceration.

Spleen enlarged. Lymphatic glands become enlarged.

In hæmorrhagic forms, hæmorrhages occur in all tissues and organs.

FORMATION OF A POCK.—Degeneration of cells commences among the prickle-cells. The cells liquefy, and lymph is also exuded, a vesicle resulting. The *vesicle* is multilocular, owing to persistence of trabeculæ, and does not collapse from a single prick. *Umbilication* is due to changes being more advanced at periphery. The *pustule* is unilocular, trabeculæ being destroyed.

Small-pox—continued.

The Virus.—Collections of epithelial cells are found in the pocks of small-pox (and of vaccinia) known as 'Guarnieri bodies'. The cells contain minute intracellular bodies, the 'elementary bodies' of Paschen. Disputed for many years whether Paschen's bodies are the virus or degenerative changes in epithelial cells. Ledingham, Amies, and others have prepared pure suspensions of the bodies and obtained following reactions:—

Elementary bodies of—

1. VACCINIA.—Agglutinated by antivaccinal serum; not by serum of small-pox convalescent.
2. VARIOLA.—Agglutinated by small-pox serum, not by antivaccinal serum (or in low titre).
3. COW-POX.—Agglutinated by anti-cow-pox and anti-vaccinal sera, not by small-pox sera.

As result of these and other experiments, Paschen's bodies can be accepted as virus of small-pox.

Mode of Infection.—The virus probably enters by mucous membrane of nose, mouth, or respiratory tract. Communicated by: (i) Infected persons; (ii) Infected articles and fomites; (iii) Third persons; (iv) Inoculation, now illegal (*see* VACCINIA, p. 254). No healthy carriers.

OCCURRENCE OF INFECTIVITY.—Infected persons undoubtedly infectious from commencement of rash, but not previously, *until skin entirely clear*. Greatest during pustulation, but also infective in *pre-eruptive period and during prodromal rash*, (not fully proved). Dried scales are main source of infection. Pustules under skin of palms, soles, or nails may not rupture, and must be cut away or infectivity remains. Dead bodies are infectious. *Virulent types* may follow infection from the mildest varioloid. Entering a room is sufficient for infection.

AERIAL TRANSMISSION over considerable distances is possible, but not fully proved. Cases occur near isolation hospitals, but some are possibly direct infection.

Duration of Infectivity.—Until, scabbing has completely ceased and all crusts separated.

Quarantine Period for Contacts.—Sixteen days. (Period usually fixed at sixteen days, but a few undoubted cases are recorded with incubation period of twenty days.)

Varieties of Small-pox.—

1. VARIOLA VERA.—(i) Discrete; (ii) Confluent. The separation is justified by the great difference in mortality.
2. HÆMORRHAGIC SMALL-POX.—(i) Black small-pox, purpura variolosa; (ii) Hæmorrhagic pustular small-pox.
3. VARIOLOID.—Small-pox modified by vaccination.

VARIOLA VERA.

Incubation Period.—Nine to fifteen days, usually twelve (fairly constant). Extreme limits possibly five to twenty-one days, or longer. No symptoms.

Clinical Stages.—(1) Invasion; (2) Initial rashes; (3) True eruption; (4) Desiccation.

Stage of Invasion.—*Prodromal period*: onset usually sudden; in adults rigors or chills; in children convulsions. *Characteristic initial symptoms* are: (i) *Frontal headache*, absence rare; (ii) *Vomiting* and epigastric pain; (iii) *Pains in back*: often also elsewhere. All three often intense.

Temperature on 1st day, 103°. *Pulse* rapid. *Constipation*. Tongue furred. Breath offensive. Throat often sore. *Restlessness*, insomnia, and often delirium. Prostration may be severe. Skin usually dry, but may be sweats. Respirations may be rapid.

Severe initial symptoms may be followed by mild attack: mild initial symptoms never by a severe attack.

Initial Rashes.—Usually on second day. Frequency varies greatly in different epidemics; up to 15 per cent of cases.

TYPE OF RASH.—(1) Scarlatiniform. (2) Morbilliform. These may be general, or approximately of the 'bathing-drawers area'. (3) Petechial, especially 'bathing-drawers area'. Rarer types: urticaria, purpura. Petechial and generalized rashes are usually followed by severe or hæmorrhagic symptoms.

Duration of initial rashes generally two days, occasionally five days: usually fade entirely just before true eruption, but may overlap.

Stage of Eruption.—This stage is here described under two divisions, *discrete* and *confluent*.

Discrete Form.

In this form the pocks remain separate from each other.

ONSET OF ERUPTION.—Third day. Appears first on forehead, back of wrists and hands. Often at the same time in mouth and fauces. Rash spreads on face, trunk, and extremities: last on lower extremities, soles, and palms: development occupies about three days. Only one crop appears.

CHARACTER OF ERUPTION.—Successively macule, papule, vesicle, pustule, and crust. Early stage of spots: *bright red macules*, diameter $\frac{1}{10}$ inch, disappear on pressure; in a few hours become *papular*, 'like shot in the skin'. On fifth to sixth day of illness *vesicles* form, with clear summits, *umbilicated*, diameter $\frac{1}{8}$ inch. On eighth day become *pustules*: spots swell, become opaque, dome-shaped, *umbilication* lost. Injected areola surrounds pustule. Skin much swollen. This *maturation* commences on face and spreads. Spots are circular in shape.

DISTRIBUTION OF ERUPTION.—Spots most numerous on face, scalp, *distal portions of extremities*, and upper back; least on abdomen, chest, *proximal portions of extremities*, and lower back; may be many thousand spots. Mostly affects parts usually uncovered: less in flexures such as axillæ and flexor surfaces.

SYMPTOMS.—With onset of rash, temperature and symptoms subside. With maturation at 8th day, general symptoms return,

Small-pox—Variola Vera—Discrete Form, *continued*.

and 'secondary fever' occurs. *Itching* extreme, and great pain from swollen skin. *Face* especially painful. *Eyelids* swollen and closed. Mouth dry and deglutition painful. Thirst extreme. *Delirium* slight or absent, but in severer cases may be acute and suicidal. Odour often distinctive, but more marked later.

STAGE OF DESICCATION.—*About tenth day* pustules commence to rupture and pus exudes. Subsequently they dry rapidly, first on face. Temperature falls gradually and convalescence begins. *By fourteenth day* decrustation advanced on face. Scabbing continues during third and fourth weeks.

TEMPERATURE.—(1) High on first day, 103° to 104° ; (2) Falls with true rash; (3) Rises again with maturation, 'secondary fever'; (4) Commences to fall between tenth and fourteenth days.

LIVER AND SPLEEN.—Not palpable. Bowels costive.

PITTING.—Slight in this form.

UNFAVOURABLE CASES.—After the eighth day typhoid state develops with extreme prostration: heart fails. Death usually twelfth to fourteenth day.

Confluent Form.

Pocks coalesce. Initial symptoms usually more severe.

ONSET OF ERUPTION.—Fourth day or earlier. The early eruption the more often is it confluent.

CHARACTER OF ERUPTION.—Passes through same stages as discrete form. In the milder cases papules are early discrete, and confluent only when pustular. In more severe cases pustules are very close, skin greatly swollen and hyperæmic. With onset of rash, temperature and symptoms subside, but not so completely as in discrete form.

On eighth day pustules form, and coalesce; large superficial abscesses result. Pustules in mouth, larynx, and pharynx. Cervical glands much swollen. Foetor extreme. *General symptoms return* in marked degree, and condition is pitiful. *Temperature* high, pulse rapid, thirst marked, delirium frequent.

DISTRIBUTION OF ERUPTION.—*Confluence* extreme on face, feet, and hands. On limbs scattered patches. On trunk, spots always discrete. The eyes are closed, skin markedly swollen. The danger to life varies with number of spots on face.

STAGE OF DESICCATION.—Pustules break and exude pus, or may desiccate unruptured. Scabbing occurs in third and fourth weeks; the crusts are very adherent and may require treatment. Pocks which remain unruptured under skin of palms, soles, and nails must be cut away.

UNFAVOURABLE CASES.—Death results from: (1) Delirium, prostration, and cardiac failure—tenth to twelfth day; (2) Hæmorrhages (*see* HÆMORRHAGIC SMALL-POX, p. 249); (3) Pneumonia during convalescence.

FAVOURABLE CASES.—Improvement commences about twelfth day. Desiccation occurs and symptoms subside.

HÆMORRHAGIC SMALL-POX.

Occurs in two forms: (1) *Black small-pox* or *purpura variolosa*;
(2) *Hæmorrhagic pustular small-pox*.

Purpura Variolosa.

FREQUENCY.—Varies in different epidemics. Most common in healthy adult males. Rare in children and vaccinated persons.

INITIAL SYMPTOMS.—As in other forms, but always severe.

ERUPTION.—Appears on second, third, or fourth day, petechial from onset, with diffuse hyperæmia. Often commences in groins, spreads rapidly, with extensive subcutaneous and cutaneous hæmorrhages, and becomes universal. Usually hæmorrhages from mucous membranes, hæmaturia, hæmatemesis, hæmoptysis, etc.

CONDITION.—Becomes appalling: face swollen, conjunctival ecchymoses, entire skin of purple hue, bloody saliva, and foul breath; extreme prostration and collapse. Mind may be clear to the end.

DEATH on third to fifth day, rarely sixth: recovery never occurs. Two groups may be distinguished: (a) Prodromal rash, usually petechial, followed by the purpuric eruption; (b) Eruption purpuric from onset. The characteristic pustular eruption is not present, and in a sporadic case the diagnosis is very difficult.

Hæmorrhagic Pustular Small-pox.

Commences as severe variola vera. Hæmorrhages commence in vesicular or pustular stage; the earlier the onset the more severe the condition. Blood appears first in areolæ surrounding spots, and spreads rapidly. Hæmorrhages from mucous membranes common.

DEATH on seventh to ninth day: recovery occasionally occurs. (In discrete form, hæmorrhages into spots on legs may occur if patient gets up too early.)

Blood Changes.—Marked polynuclear leucocytosis in all forms.

VARIOLOID.

Modified form occurring in vaccinated persons. Onset abrupt. Initial symptoms may be severe as in other forms. Rash, as papules, appears on third or fourth day. With eruption, temperature and symptoms subside. No secondary fever occurs. Stages of vesicle and pustule are short. Various stages may be present together from arrest of development. Pitting rare. Within five years of vaccination varioloid is rarely severe, but occasionally is fatal.

NOTE.—These cases are infectious, and virulent types may occur in the infected.

COMPLICATIONS.

BRONCHOPNEUMONIA present in all fatal cases.

DELIRIUM AND COMA. Convulsions common in children.

LARYNGITIS may be dangerous from œdema of glottis, aspiration pneumonia, or necrosis of cartilages.

ALBUMINURIA frequent, but nephritis rare.

Small-pox—Complications, continued.

CONJUNCTIVITIS common, but usually avoidable with care.

KERATITIS not uncommon in confluent form.

SEPTICÆMIA may develop in pustular stage or later.

ENCEPHALOMYELITIS—very rare.

Sequelæ.—

PITTING.—Especially on face in confluent form.

BOILS AND ABSCESES.—Very frequent and troublesome.

Cellulitis and erysipelas occasionally during scabbing.

OSTEOMYELITIS VARIOLOSA.—Destroys epiphysial lines in growing bones. Non-suppurative. Often unrecognized until defective growth.

Rare: Post-febrile insanity.

A secondary eruption occasionally occurs during desquamation, so-called 'recurrent small-pox'.

PROGNOSIS.

Depends on :—

1. VACCINATION.—In vaccinated persons mortality very low. A few per cent in most unfavourable circumstances. With successful re-vaccination, mortality nil. (*See VACCINIA*, p. 254.)
2. AGE.—In unvaccinated persons mortality highest in infancy, diminishes in childhood, and then increases progressively. Average about 25 to 35 per cent.
3. CLINICAL TYPE.—Hæmorrhagic form practically always fatal. Confluent form, mortality about 50 per cent. Discrete form about 5 per cent.
4. SPECIAL SYMPTOMS.—Prognosis depends especially on *amount of eruption on face*. Unfavourable symptoms also are delirium, high temperature, laryngitis, and pulmonary affections, especially in children.
5. VIRULENCE OF EPIDEMICS.—This varies very greatly.

DIAGNOSIS.

Great difficulty of diagnosis is due to : (a) Resemblance to chicken-pox ; (b) Occurrence of mild cases. Principal points are :—

Distinction from Chicken-pox.—

1. PROSTRATION.—Marked in small-pox.
2. DISTRIBUTION OF RASH.—Spots counted and charted on hand, forearm, upper arm, foot, leg, thigh. In small-pox larger numbers centrifugally ; in chicken-pox larger numbers centripetally. Also compare face and trunk. Most reliable early sign.
3. DEPTH OF SPOTS.—In chicken-pox superficial even to inspection. In small-pox, mild and severe, deeper and often with 'shotty' feel.
4. SHAPE OF SPOTS.—In chicken-pox *some* elliptical or oval spots can be found in groins and folds of skin : not in small-pox.

5. In chicken-pox, fresh crops occur on several successive days; hence all stages are present simultaneously. Never in small-pox.

6. In chicken-pox, vesiculation and crusting of some papules will occur very early, may be within two days.

Further points in chicken-pox are: (i) Rash usually present on first day; (ii) Fever does not fall with eruption; (iii) Spots unilocular and collapse on pricking; (iv) No umbilication; (v) Areola rare round spots.

Initial Rashes.—May simulate scarlet fever, rubella, or measles. Other symptoms differ. Transient.

Rarely, difficulties from: hæmorrhagic scarlet fever and measles, typhus, rubella, erythematæ.

True Rash.—To be distinguished from chicken-pox, measles, drug eruptions (especially pot. iodide).

Paul's Test.—Widely used on Continent. Liquid contents of a vesicle diluted and placed on scarified surface of a rabbit's cornea. In 48 hours small elevations appear on inoculated eye. On microscopic examination of excised cornea, Guarnieri's bodies present (*see* VIRUS). Test positive in small-pox, negative in chicken-pox. (Absent or slight in alastrim.)

PROPHYLAXIS.

VACCINATION and re-vaccination: repeated after exposure to infection. (*See* VACCINIA, p. 254.)

DURING AN EPIDEMIC.—General vaccination. Complete isolation of contacts. Great care in diagnosis of mild cases. (*See also* MODE OF INFECTION, p. 246.)

TREATMENT.

Isolation in special hospitals imperative. No specific treatment exists. Varioloid and discrete cases require little special treatment. In severe cases treatment especially for eruption and constitutional symptoms.

GENERAL HYGIENE.—Bed, fresh air, plenty of fluid, milk diet. Water bed if necessary. *Nose and mouth*: swabbed gently or syringed (*see* SCARLET FEVER, p. 129). Ice to suck when mouth affected.

INITIAL SYMPTOMS.—*Pains* need opium. *Vomiting*: ice and champagne, and opium. *High temperature*: hydrotherapy, especially cold packs.

ERUPTION.—Cut hair short. In early stages lint mask over face. Moisten with cold water or 2 per cent carbolic. Cover with oiled silk. Itching in all parts is relieved by cold and moisture. When crusts form, skin must not be allowed to dry. Best for face is a mask of thin linseed poultice covered with a little vaseline and frequently renewed. For body, moisten with glycerin or vaseline. For unruptured pustules, especially under nails, incise and treat aseptically.

All treatment with oil, liniments, etc., useless, and probably delays separation of crusts.

Small-pox—Treatment, *continued*.

BATHS.—Continuous warm bath most valuable. Should be used in all cases of suppuration, confluent spots, or toxæmia, and also to hasten separation of crusts.

EYES.—Treatment of great importance. Bathe with boracic lotion, smear edges of eyelids with vaseline. Usual treatment for keratitis.

HÆMORRHAGIC CASES.—No treatment of any effect. Hæmostatics useless.

VARIOUS SYMPTOMS AND COMPLICATIONS.—*Delirium and sleeplessness* need opium. For *cardiac weakness* give alcohol and stimulants. Great swelling of tongue may need incisions. Laryngitis: tracheotomy may be necessary.

PROTECTION FROM LIGHT.—Maturation is less when spots are guarded from light.

CONVALESCENT SERUM.—Injections (25 c.c.) under trial.

CONVALESCENCE.—Give frequent baths to hasten separation of crusts. Convalescence usually rapid. *Boils*: open on formation, and give continuous warm bath.

ALASTRIM OR VARIOLA MINOR.

(*Para-small-pox. Amaas. Mild Small-pox. Varioloid Varicella*.)—

Epidemics are characterized by persistent mildness of great majority of cases, and by trifling mortality of all cases, mild or severe.

Nomenclature.—The International List of the Causes of Death uses 'Variola Minor': open to objection of former use for mild forms of severe small-pox.

Symptoms.—

INITIAL SYMPTOMS.—Moderate pyrexia, headache, backache, nausea or vomiting. Usually mistaken for influenza or gastritis. These symptoms may be absent. They pass rapidly, and patient often feels well for two or three days. No prodromal rashes.

ERUPTION.—Commences on third to seventh or tenth day. No secondary fever or malaise during eruption, or slight if rash profuse. Onset on face and neck, then on trunk, and last on extremities. Develops in 1 to 2 days. Only one crop.

NUMBER OF SPOTS.—Usually scanty. Profuse in about one-third. Occasionally generalized, and may be confluent.

DISTRIBUTION.—Centrifugal. Scanty on trunk, chiefly on limbs: may be on palms and soles.

PROGRESS OF ERUPTION.—Commences as macule and papule. Vesicle forms with *opalescent* fluid (milk-pox), or papule passes direct to vesiculo-pustular stage. Pocks unilocular and rarely umbilicated. More superficial than usual in small-pox, and progress more rapid.

Desiccation follows. Top falls off, leaving purplish stain or may be central depression. Pitting absent or very slight. Eruption frequently aborts. Many spots subside as pimples. Others do not reach surface and are absorbed.

Mortality.—Negligible. Even with confluent rashes, constitutional symptoms are trifling.

Diagnosis from Chicken-pox.—By distribution of eruption, and absence of successive crops.

Pathogenesis.—Problems arising are: (1) Are small-pox and alastrim due to same virus? (2) Can alastrim give rise to small-pox, granting that the virus is the same? (3) Is it possible to recognize (a) individual cases, (b) epidemics of alastrim? (4) What measures are necessary in an epidemic of alastrim?

1. ARE SMALL-POX AND ALASTRIM DUE TO SAME VIRUS?

Note:—

- a. Symptoms of alastrim are identical with those of certain mild cases of small-pox which may occur even in severe epidemics.
- b. Relations to vaccinia are practically identical, viz.:—
 - i. Vaccinia protects man against small-pox and alastrim, and either protects against vaccinia.
 - ii. Rabbit inoculated either with small-pox or alastrim is refractory to vaccinia.

CONCLUSION.—Small-pox and alastrim are due to the same or closely-allied virus.

Note.—Calves are insusceptible to inoculations of alastrim, evidence that virus is not identical.

2. CAN ALASTRIM GIVE RISE TO SMALL-POX? Note:—

- a. An epidemic remains almost constantly mild, and the same clinical picture persists, however prolonged and extensive the outbreak may be. No known instance of an epidemic of alastrim 'turning into severe small-pox'.
- b. Patients with profuse and even confluent eruptions in epidemics of alastrim have but slight constitutional disturbances, and mortality is trifling, widely differing from small-pox. Cases infected from such patients have features and mortality of alastrim and not of small-pox. Thus these are severe cases of alastrim (cf. generalized vaccinia) and not cases of small-pox, and do not lead to small-pox.

CONCLUSION.—Alastrim does not give rise to small-pox.

May the Alastrim Virus be Expected to Acquire the Full (Small-pox) Virulence? Compare the position of vaccinia:—

- i. Virus of vaccinia accepted as modified variola virus.
- ii. Vaccinia over many years has shown no signs of returning to virulence of small-pox or of producing it.

Hence even a modified virus may persist permanently.

Conclusion.—There is no reason to expect alastrim virus to acquire small-pox virulence.

3. IS IT POSSIBLE TO RECOGNIZE (a) INDIVIDUAL CASES, (b) EPIDEMICS OF ALASTRIM? Note:—

- i. Mild cases are indistinguishable in a single instance, but occurrence of numerous mild cases is rare in small-pox.

Small-pox—Alastrim—Pathogenesis, *continued*.

- ii. Severe cases of alastrim differ from small-pox in the absence of toxæmia and in low mortality.
 - iii. An epidemic of alastrim thus should be distinguishable from small-pox in the course of several weeks. (Vaccination protects against alastrim for many years.)
4. WHAT MEASURES ARE NECESSARY IN AN EPIDEMIC OF ALASTRIM?—The full precautionary measures of small-pox are unnecessary in an epidemic of alastrim, *when it can be definitely recognized as such*.

Comparison of Small-pox, Vaccinia, and Alastrim.—

- 1. SMALL-POX.—Virus of variola :—
 - i. Is infectious by its natural, though unknown, path and by inoculation.
 - ii. Reproduces small-pox.
 - iii. Protects against vaccinia.
- 2. VACCINIA.—Virus of variola, modified by passage through calf's skin :—
 - i. Loses its infectivity by its natural path, retains it to inoculation.
 - ii. Loses power of producing small-pox and causes only vaccinia.
 - iii. Cannot be restored to full virulence.
 - iv. Protects against small-pox and alastrim.
- 3. ALASTRIM.—Virus allied to variola :—
 - i. Is infectious by a natural path (? loses it to inoculation).
 - ii. Reproduces only alastrim.
 - iii. Protects against vaccinia, and probably small-pox.

CHAPTER XXXVII.

VACCINIA (*Cow-pox*). VACCINATION.

Vaccinia is an acute infective disease of cows characterized by a vesicular eruption on the udders and teats, caused by a virus which on inoculation protects man against small-pox.

History.—

VARIOLOUS INOCULATION.—Inoculation of variolous matter, i.e., from pustule of small-pox, practised in East for many centuries. Commonly caused mild typical attack of variola, but sometimes fatal. Introduced into England in 1717 by Lady Mary Wortley Montagu.

Careful inoculation would certainly have lowered the death-rate, but inoculated persons are infectious, and in absence of precautions spread disease. The method, once largely practised, fell into disrepute; it was finally declared illegal in 1840.

JENNER'S DISCOVERY OF VACCINATION.—

A traditional country belief existed that an attack of cow-pox protected against small-pox. First inoculations with cow-pox matter as a prophylactic by Jesty, a farmer, in 1774, on his wife. Jenner conceived idea of protective inoculation with cow-pox matter about 1780. Was hampered by rarity of cow-pox in his district, but separated two forms of cow-pox previously confused, only one of which was protective, and investigated swine-pox and grease of horses: the latter similar to vaccinia. Finally, in 1796, he made a crucial experiment by inoculating a boy with matter from the hand of a girl infected with cow-pox, and found that immunity resulted against subsequent inoculation with small-pox matter. Similar experiments were made the year following, and in 1798 Jenner published his method. *Woodville*, 1799, introduced arm-to-arm vaccination. *Waterhouse*, in America, in 1800, repeated Jenner's experiments and confirmed the resulting immunity.

Vaccination spread rapidly in all civilized countries. Opposition tended to grow after some years, as vaccinated persons contracted small-pox. Unfortunately, Jenner, to his death in 1823, never recognized necessity for re-vaccination, and tried to make excuses for every case of failure. He considered variola and vaccinia identical. His main discovery was that matter from a human being with cow-pox protected another against small-pox.

RE-VACCINATION.—Commenced between 1820-1830, the value becoming slowly recognized.

Relation of Vaccinia to Variola.—Not fully proved whether vaccinia is an independent disease or variola modified by passage through the cow. The following experiments suggest that vaccinia was originally due to inoculation of calves with small-pox matter, and *vaccinia is generally accepted as being modified variola*. Important relations are:—

1. Cow-pox or matter from vaccinia on inoculation into man never produces variola.
2. Vaccinia is only infective when matter from it is inoculated into an abrasion of the skin.

These two points are specially advanced by those upholding independence of the two conditions.

3. Vaccinia protects against variola and variola against vaccinia. No instance is known in which one disease protects against another.
4. Inoculation of calves with variolous matter from man never produces variola. In majority of cases no definite lesion follows in first series, but after passage through several calves definite vaccinia results. The lymph from these produces typical vaccinia, and never variola, either in children or calves. Experiments are few but carefully authenticated.

Vaccinia—Relation to Variola, continued.

5. Variolous matter inoculated into monkeys, after several passages, and then on to calves, produces vaccinia readily.

Preparation of Vaccine Lymph.—Calves are vaccinated with lymph on abdomen aseptically. Lymph derived originally from *human small-pox* and not cow-pox has been used in recent years. The contents of the vesicles are scraped, mixed with glycerin, and stored until sterile; extraneous organisms die out in three to four weeks. Rabbits and hen's eggs are also used.

Technique of Full Vaccination.—Cleanse skin with soap and water, and then ether. Scarify in four places over $\frac{1}{2}$ inch apart, without definite bleeding. Place drop of lymph on each and rub in with the needle. Leave to dry without covering at least a quarter of an hour. Cover with lint, and protect vesicle and pustule from rupture by gauze and strapping.

Site.—Over deltoid or above knee.

Intracutaneous Method.—Lymph diluted with saline 40 to 100 times: use 0.1 c.c. Needle inserted subcutaneously and then upwards into skin. Pimple forms in 2 days. Red infiltration, sign of success, forms in 10 to 14 days. No scar. Subject subsequently refractory to ordinary vaccination.

(See also RECOMMENDATIONS OF ROLLESTON COMMITTEE, p. 257.)

Symptoms of Normal Vaccination.—**LOCAL SYMPTOMS.**—

Third day: *Papule* with red zone.

Sixth day: *Vesicle* with umbilication, red zone increases.

Eighth day: Vesicle of maximum distension, marked umbilication.

Tenth day: *Pustule*. Skin swollen and painful.

Twelfth day: Pustule commences to dry; hyperæmia diminishes.

Scab separates about twenty-first day and leaves scar.

CONSTITUTIONAL SYMPTOMS.—Variable in degree: malaise and restlessness may be considerable. Pyrexia, usually slight, third to eighth day with eruption. Axillary (or inguinal) glands palpable. Definite leucocytosis.

Abnormalities of Vaccination.—

1. Local vesicles may form round primary zone.
2. Transient rashes, erythema or urticaria, in second week; rarely purpura.
3. Inflammations and deep ulcers may result from uncleanness and secondary infections, or from injury: usually weak subjects.
4. *Generalized Vaccinia.*—Very rare. A general pustular eruption, usually commencing on eighth or tenth day: formation of pustules may continue for several weeks. In children occasionally fatal.

5. Post-vaccinal encephalitis (*see below*).

All severe complications are extremely rare.

Postpone vaccination of children who have specific or skin diseases or any marked ailment.

Transmission of Disease by Vaccination.—

SYPHILIS.—Transmission by vaccination was possible in arm-to-arm inoculations, but not with modern calf lymph.

TETANUS.—Cases have occurred.

TUBERCULOSIS.—No undoubted case is known.

Recommendations of Rolleston Committee.—

1. Primary vaccination to be performed in infancy between ages of 2 and 6 months.
2. Re-vaccination at 5 to 7 years and again at 14 to 16 years.
3. Trial to be made of vaccination in one insertion with a minimum of trauma; and by simple application of lymph without criss-cross scarification.
4. Primary vaccination of persons of ages susceptible to post-vaccinal encephalitis not to be pressed, so long as small-pox in this country retains its mild character, unless subject has been in personal contact with a case of small-pox or directly exposed to infection. (Ministry of Health.)

Symptoms in Re-vaccination.—Lesions and symptoms in re-vaccination may be identical with primary vaccination, especially after long intervals; in other cases course is shorter and less severe, and all degrees occur to complete absence of reaction.

Duration of Immunity and Value of Vaccination.—

Immunity is complete three weeks from vaccination.

After exposure to infection, *immediate vaccination* protects completely, or will greatly modify course of variola: vaccination later in the incubation period will modify course if eruption of vaccinia appears two or three days before variola commences.

Degree of protection varies with effective vaccination. With complete vaccination and re-vaccination mortality is nil. With four marks case-mortality is 2 to 3 per cent and case-incidence low.

(*See also* VARIOLOID, p. 249.)

Duration of Protection.—Probably ten to fifteen years.

POST-VACCINAL ENCEPHALITIS.**Etiology.—**

DISTRIBUTION.—Most cases in Netherlands and British Isles, but occurs in all countries.

AGE.—Children and adolescents: most susceptible between 3 and 13 years. Infants and adults almost exempt.

Post-Vaccinal Encephalitis—Etiology, *continued*.

FREQUENCY.—Statistics uncertain at present: in Netherlands not more than 1 in 3000.

Morbid Anatomy.—

MACROSCOPIC.—Brain congested; punctate hæmorrhages, rarely gross hæmorrhages. Note: Often no changes visible.

MICROSCOPIC.—

1. 'Perivascular demyelination': around veins, along central fissure of cord, and beneath pia and ependyma. Pons, medulla, and lumbar cord most affected.
2. 'Perivascular cuffing': infiltration of perivascular lymph spaces with lymphocytes and plasma cells.

Symptoms.—

INCUBATION PERIOD.—Usually 11 to 13 days; limits, 9 to 19 days. Local reaction not marked.

MODE OF ONSET.—Sudden or rapid.

CARDINAL SYMPTOMS.—Raised temperature, headache, vomiting, and drowsiness. No ocular paralyses.

COURSE.—No constant clinical course. Different cases may exhibit especially (Ledingham): (1) Convulsions and paralyses (ocular palsies very rare); (2) Meningeal symptoms only; (3) Tetanus-like symptoms; (4) Bladder and rectal disturbances; (5) Spinal-cord symptoms—as in acute poliomyelitis.

Deep reflexes absent. Muscle tone low. Babinski's sign positive in 10 per cent.

Cerebrospinal fluid under pressure, but clear fluid.

Prognosis.—Death in coma in 40 per cent. Complete recovery in remainder; residual symptoms extremely rare.

Relation of Post-vaccinal Encephalitis to Vaccination.—

1. Occurrence is not fortuitous: the two are undoubtedly related.
2. No relation to any one mode of preparation or strain of vaccine.

3. Theories of Mode of Action :—

- i. Vaccinia virus acts alone directly on nervous system.
- ii. Vaccinia stirs to activity a latent virus.

In support of (i): Vaccinia virus has been present in brains of certain fatal cases. But presence may be normal at such period after vaccination.

Rolleston Committee supported (ii): "a co-operation of vaccinia with the viruses of poliomyelitis or encephalitis lethargica or possibly some unknown neurotropic virus harboured by a vaccinated subject."

At present, question is unsettled and (i) is a possibility.

4. Occurrence is nearly always following a primary vaccination in children or adolescents.

Note.—In Netherlands primary vaccination is usually at school age.

CHAPTER XXXVIII.

CHICKEN-POX.

(Varicella.)

An acute infectious disease, due to a virus, and characterized by a vesicular eruption usually appearing in successive crops. Rarely severe.

Etiology.—Endemic and sporadic, occasionally epidemic.

AGE.—Usually under 10 years. Infants may be attacked. Adults very liable, if no attack in childhood.

SEASONAL VARIATIONS.—Slight.

RELATION TO VARIOLA.—Entirely distinct. Note :—

1. No mutual immunity conferred by an attack of either.
2. Patient with varicella can be vaccinated.
3. No cases of variola occur during epidemic of varicella.

Chicken-pox may follow contact with case of zoster.

Morbid Anatomy.—The formation of a pock commences in the middle layer of the prickle cells. The nuclei divide, and the cytoplasm becomes swollen and vacuolated, degenerates, and liquefies. Lymph is exuded.

Mode of Infection.—*Highly contagious.* By direct contact, by infected articles, by third persons, or by the air over short distances. Can be inoculated by fluid of vesicles.

One attack usually, but not invariably, protects. Insusceptibility probably not uncommon (infectivity uncertain).

The Virus.—Paschen's elementary bodies are present in fluid of vesicles : pure suspension is agglutinated by serum of chicken-pox convalescents (*see* SMALL-POX).

Duration of Infectivity.—Until all crusts have separated without re-forming, usually about one month. Delay frequently caused by one or two obstinate pocks.

Quarantine Period for Contacts.—Three weeks.

Symptoms.—

INCUBATION PERIOD.—Eleven to nineteen days, usually fourteen to sixteen days. Limit : twenty-four days. No infectivity under ten days from exposure.

STAGE OF INVASION.—In *children*, usually slight fretfulness and anorexia. In *adults*, pyrexia, slight chill, vomiting, pains in back, usually slight, rarely severe and suggestive of small-pox.

—*Prodromal rash*, a general erythema, occasionally occurs. Initial symptoms often overlooked until eruption attracts attention.

ERUPTION.—On first or second day. Fever does not disappear with eruption, but symptoms are slight throughout.

ORDER OF APPEARANCE OF ERUPTION.—*Earliest on trunk*, either back or chest. Rarely on forehead or limbs. Few spots in mouth at same time. No constant sequence subsequently.

Chicken-pox—Symptoms, continued.

DISTRIBUTION OF FULL ERUPTION.—Usually characteristic : (a) Trunk and scalp most affected ; (b) Face and limbs less so, and *proximal* portions more affected than distal. Few spots on palms and soles, often none. May occur on palate. Some times on labia and in urethra. On scalp, hands, and feet the vesicles are small and may be 'shotty'.

CHARACTER OF ERUPTION.—Rose-coloured *papules*, changing in few hours into *vesicles*, size of match-head. Contain clear serum. No umbilication. Unilocular, and collapse on pricking. Firm, but more superficial than, and without shotty feel of, small-pox. Always discrete. Skin around normal, or slight red areolæ. Oval spots present in groins and folds of skin. *Pustules* form in forty-eight hours : later shrivel and form crusts.

SUCCESSIVE CROPS.—On subsequent days. Usually three in all.

ALL STAGES OF ERUPTION SIMULTANEOUSLY PRESENT, even among those of similar date.

NUMBER OF SPOTS.—Ten to several hundreds.

PROGRESS OF ERUPTION.—The progress of different spots usually varies ; some vesicles may not become pustular.—

1. Pustule remains unruptured, falls off in five days to two or, rarely, three weeks, leaving dry surface, no scar.
2. Pustule ruptures from scratching or injury. Thin crust forms, dries rapidly, scab falls in one to three weeks.
3. Pustule ruptures, skin around becomes inflamed, crust forms with suppuration below, falls off in one to two weeks. Surface ulcerated but heals rapidly. Scar often results. More common in children, especially on face.

Constitutional Symptoms.—General disturbance depends on number of spots, amount of pustulation, and ulceration. *Itching* may be severe and cause insomnia. *Temperature* 99° to 101° ; occasionally 103°, but rarely longer than three to four days. Often rises with each crop. Falls rapidly. May rise again in second week with suppuration under crusts. *Constitutional symptoms* rarely severe, even with the higher temperatures, except in debilitated subjects. In adults both eruption and constitutional symptoms often severer.

Encephalomyelitis (encephalitis) is a rare sequel : pyrexia, headache, vomiting, and various nervous symptoms. Mortality very low.

Variations in Eruption.

NECROSIS AND ULCERATION.—Not uncommon in uncleanness. General symptoms severe, varying with degree of ulceration. Is cause of most fatal cases. *Gangrene* round vesicles rare.

VARICELLA BULLOSA.—Rare. Large bullæ develop from the vesicles. Severe itching and general symptoms.

HÆMORRHAGIC VARICELLA.—Very rare. Recoveries occur.

Duration.—Acute stage three to seven days, depending on number of crops : rarely twelve days. (See DURATION OF INFECTIVITY, p. 259.)

Diagnosis.—Usually simple. Characteristics are: (a) Order of onset of rash; (b) Distribution; (c) Successive crops; (d) Various stages of eruption simultaneously present—papules, vesicles, and pustules; (e) Symptoms slight, but temperature does not fall with appearance of rash.

VARIOLA.—See SMALL-POX—DIAGNOSIS, p. 250.

IMPETIGO CONTAGIOSA.—Mostly on face. Mucous membranes not affected.

HERPES ZOSTER.—Definite distribution corresponding to nerve roots. Some evidence exists that virus is the same.

Treatment.—For mild cases, no special treatment. *Itching*: sponge with warm boracic lotion, or dust with starch and zinc oxide powder. Prevent scratching. Cut hair if much eruption on scalp. For ulceration, apply hot fomentations. Warm bath hastens separation of scabs, but these re-form if separated too early.

CHAPTER XXXIX.

MEASLES.

(*Morbilli*.)

An acute infectious disease of unknown origin, and extreme contagiousness, characterized by coryza, a skin eruption, and catarrh of the upper portion of the respiratory tract.

Etiology.—

CLIMATE.—Endemic and epidemic in temperate regions, but no zone exempt.

SEASON.—In British Isles, maxima in December and June.

SUSCEPTIBILITY.—Universal. *Most contagious* of all fevers.

AGE.—No age immune, but in civilized countries few escape past childhood.

ONE ATTACK PROTECTS.—Second attacks almost invariably include an error in diagnosis.

Morbid Anatomy.—Nothing characteristic. *Bronchopneumonia* almost invariable in fatal cases. *Tuberculosis* is a common sequel.

Mode of Infection.—Specific virus unknown. Present in secretion of nose, mouth, and respiratory tract: and apparently in blood and skin. *Transmitted* by direct contact. Possibly, but not indisputably, by third persons, clothes, etc., but, at most, only for short distance and time. Never milk- or water-borne.

Tunncliffe's green-producing anaerobic diplococcus is not generally accepted.

EXPERIMENTAL INOCULATION.—Transmitted to man by inoculation of blood (Hektoen): also to Rhesus monkeys by blood and mucous secretions, but not by epithelium (Anderson).

Duration of Infectivity.—*Contagiousness* is especially marked in catarrhal pre-eruptive stage, probably greatest on first day of

Measles—Duration of Infectivity, *continued*.

prodromal symptoms. Very slight after rash fades, and may be considered *absent two weeks from onset of rash*, except with pulmonary and other complications. Probably no carriers, since 'return cases' do not occur (cf. SCARLET FEVER, p. 122).

Quarantine Period.—For contacts, three weeks: must then be no catarrh or fever.

Symptoms.—

INCUBATION PERIOD (to onset of prodromal symptoms).—

Usually nine to seventeen days. Limits, seven to twenty-one days. No infectivity under seven days from exposure to infection.

PRODROMAL STAGE.—*Period of invasion and catarrhal symptoms.* Duration usually four days. Extremes three to six days.

ONSET OF SYMPTOMS.—Usually abrupt, but may be insidious.

(1) Coryza with sneezing and thin nasal discharge; (2) Redness of the conjunctiva and lids, lachrymation, often photophobia. (3) Pyrexia moderate, commonly 102° . Cough and voice hoarse, tongue furred. Patient thirsty, restless, and irritable. May be nausea or vomiting and headache. Occasionally epistaxis. Convulsions in severe cases.

ON SECOND AND THIRD DAY.—*Face becomes puffy*: coryza, bronchitis, and conjunctivitis increase, and appearance becomes suggestive. *Koplik's spots* now appear.

Temperature commonly falls. A distinct remission of symptoms may occur and be deceptive.

Mucous membrane of mouth and throat hyperæmic and dry.

Laryngitis is common.

Glands behind jaw frequently palpable.

PRODROMAL RASHES.—Occasionally on first or second day: (1) Erythema resembling scarlet fever, most common: usually on trunk only. (2) Blotchy erythema resembling true rash of measles.

KOPLIK'S SPOTS.—*Minute white specks* surrounded by red areolæ on buccal mucous membrane, most commonly at level of lower second molar or milk molars. Numbers very variable; and distribution may be extensive. Areolæ frequently absent, as noted by Goodall. Appear usually on second day. Disappear rapidly after eruption comes out. Presence very constant and pathognomonic (difficult to see by artificial light).

STAGE OF ERUPTION.—Symptoms increase until fourth day, when the eruption appears.

ORDER OF ONSET OF ERUPTION.—Earliest on temples, on forehead at margin of hair, and behind ears. Spreads rapidly in a few hours over face, trunk, and finally limbs. Feet and hands are last affected. Maximum in one to three days. Amount of eruption varies, but some normal skin is always present.

CHARACTER OF RASH.—*Early stage*: small red spots like flea-bites, or diffuse redness, disappearing on pressure. *Typical*

eruption develops a few hours later: irregular, blotchy, crescentic patches of erythema, dusky red; edges feel raised to the finger; do not disappear entirely on pressure. The rash fades with cold, and becomes more marked with warmth.

PROGRESS.—*Catarrhal symptoms do not subside* with eruption, but continue till fifth or sixth day. *Bronchitis* develops, scattered rhonchi and râles in lungs. *Laryngitis* common. *Diarrhœa* occasionally. *Fever* rises to maximum (104°) with appearance of rash. Pulse and respiration rapid. Dry cough. Restlessness and insomnia: may be delirium.

DURATION OF ERUPTIVE STAGE.—Three or four days; rarely six. *Commences to fade* in twenty-four hours, in order of appearance: may fade on face before appearing on limbs; last on hands, wrists, and feet. Brownish stain lingers. Desquamation of fine branny scales, varying with profuseness of rash: duration up to ten days.

TEMPERATURE CURVE.—In typical cases, moderate pyrexia on first day (102°); fall on second day (100° to 101°); rises to maximum at onset of rash (104° to 105°). Falls rapidly as rash commences to fade, and normal about seventh day from onset. Delayed by pulmonary or other complications.

VARIATIONS IN RASH.—*Petechiæ* occur with lice or cachexia: usually near joints. The typical rash, in areas where confluent, may resemble scarlet fever.

CONVALESCENCE.—Rapid, in absence of complications. Usually no symptoms in ten days from onset. Cough persists longest.

The Blood.—Leucopenia: some plasma cells but not constant. Slight leucocytosis during incubation period.

Variations in Clinical Type.—All are rare.

MILD FORMS.—*Catarrhal symptoms absent*: convalescence by fifth day.

MORBILLI SINE MORBILLIS.—Clinical symptoms without an eruption. Occurs in: (1) Mild cases (rash may be transient). (2) Severe cases: usually cachectic patients: typhoidal condition develops, with collapse and death: absence of eruption may be due to death occurring before eruptive period or to rash fading through failure of circulation (the layman's 'rash driven inwards'). Recognizable in epidemics by Koplik spots and by exposure to contagion and transmission to others.

HÆMORRHAGIC MEASLES ('Black Measles').—Extremely rare. Occasionally in epidemics. Widespread hæmorrhages of skin and mucous membranes, marked toxæmia. Death second to sixth day. Many epidemics of 'black measles' formerly described were probably erroneous diagnoses, e.g., small-pox.

Relapses.—Very rare. Once in several thousand cases.

Complications.—Severe complications are:—

1. **BRONCHITIS AND BRONCHOPNEUMONIA.**—*Bronchitis* is practically constant. Usually first evident during eruption. *Bronchopneumonia* serious and not uncommon, is cause of

Measles—Complications, continued.

most deaths; convalescence slow. Other respiratory complications: *Laryngitis*, mild form almost constant; severe form followed rarely by œdema glottidis, pseudomembranous laryngitis, or perichondritis. *Lobar pneumonia* rare.

2. **STOMATITIS AND NOMA.**—Mucous membrane of mouth constantly affected in some degree. May be severe ulceration: serious. *Cancrum oris* or *noma* is almost limited to measles, always fatal; may affect vulva.
3. **OTITIS MEDIA.**—Not uncommon. Mastoid abscess, meningitis, etc., may follow.
4. **DIARRHŒA.**—Common during eruption.
5. **ENCEPHALOMYELITIS (*Encephalitis*).**—Rare complication. Sudden onset during or few days after attack. Fever, headache, drowsiness or irritability: occasionally vomiting, hyperæsthesia, paralyses. Cerebrospinal fluid under pressure: cells increased. *Mortality* about 10 per cent; complete recovery 25 per cent; residual symptoms in 65 per cent. *Treatment*: Sedatives.

Other rare complications are: Nephritis; endocarditis.

Sequelæ.—*Pulmonary tuberculosis* not uncommon: high mortality. *Chronic bronchitis* and recurrent bronchitis. *Enlarged tonsils and adenoids*. Occasionally pustular eruptions.

Association with other Diseases.—Common with other specific fevers, especially diphtheria (serious), scarlet fever, and whooping-cough. Owing to these conditions being common at same age as measles, exact relations of their association are still in dispute.

Diagnosis.—Difficulty may arise with:—

SCARLET FEVER.—In measles: (i) Longer prodromal period; (ii) Affects mouth rather than throat; (iii) Marked catarrhal symptoms and conjunctivitis; (iv) Rash: blotchy, crescentic, commences on forehead, and affects face; no circumoral pallor; (v) No leucocytosis; (vi) Koplik spots diagnostic. Vomiting less common. Desquamation branny only. In anginose scarlet fever, rash on extremities is often macular.

RUBELLA.—(i) Shorter prodromal period; (ii) Slight symptoms, eyes clear; (iii) Occipital glands enlarged; (iv) Rash usually a punctate erythema.

URTICARIA.—This may suggest the rash of measles, but other symptoms absent.

SMALL-POX.—Prodromal rash and early symptoms may resemble measles, and vice versa.

Prognosis.—Immediate mortality practically confined to broncho-pneumonia; noma invariably fatal, but rare; diphtheria, high mortality; occasionally from diarrhœa, etc. Great care is necessary during convalescence. Mortality varies with age, being higher in infancy and in old age, with poor social conditions and environment, and also in different epidemics. Mortality in general

about 3 per cent. Subsequent to attack, pulmonary tuberculosis may be fatal. Epidemics among unaccustomed adult populations have caused enormous mortalities.

Prophylaxis.—Prevention of spread difficult, owing to long prodromal period and contagiousness in early stages. Cessation of infectivity rapid: disinfection of room apparently unnecessary after patient's discharge.

Prophylactic Serum Treatment.—Serum from measles convalescents protects children exposed to infection.

MODE OF COLLECTION.—Blood from convalescents preferably 6 to 9 days after temperature normal. (Test for Wassermann reaction.)

DOSAGE.—Under age of 3 years: 6 c.c. or less. Over 3 years: 6 to 10 c.c. Intramuscular injection.

RESULTS.—(1) Within 5 days of exposure: Protects against attack (sero-prevention). Immunity lasts 2 to 4 weeks. (2) Later in incubation period: Modifies attack (sero-attenuation), which causes permanent immunity.

INDICATIONS.—Especially for children under 3 years: preferably sero-attenuation.

ADULT SERUM.—Use if convalescent serum unobtainable. Double dose.

PLACENTAL EXTRACT ('Human Immune Globulin').—Under trial: results promising.

Note.—Degkwitz's serum is worse than useless.

Treatment.—Danger arises from the respiratory complications.

Treatment aims at: (1) Avoiding complications; (2) Treating symptoms; (3) Preventing spread of infection.

In ordinary cases no other treatment necessary.

GENERAL HYGIENE.—Bedroom temperature 63°; free ventilation; light covering, flannel on chest; bronchitis kettle in room, containing tinct. benzoin. co.; aperient (calomel); no bath until rash subsides. For photophobia, screen from light.

MOUTH AND STOMATITIS.—Swab with diluted tincture of myrrh and borax.

CONJUNCTIVÆ.—Bathe with boracic lotion.

COUGH AND BRONCHOPNEUMONIA.—See ACUTE BRONCHITIS and BRONCHOPNEUMONIA. *Stimulants necessary.*

LARYNGITIS.—If severe, bronchitis kettle in tent. Fomentation over trachea (avoid blistering); usually subsides with eruption. Tracheotomy rarely necessary; intubation only in hospitals. Remember diphtheria is possible.

PYREXIA AND DELIRIUM.—Sponging, cold packs. Ice to head.

COLLAPSE, CYANOSIS with high fever.—Mustard bath.

DIARRHŒA.—Castor oil. Low diet. Bismuth and opium mixture. (See DIARRHŒA).

VOMITING.—Peptonized milk. Bismuth.

Measles—Treatment, continued.

SKIN AND RASH.—For itching: carbolized vaseline. During desquamation, rub with oil. Hot drinks or baths if eruption does not develop.

CONVALESCENCE.—In bed until temperature normal for a week. Out of doors after another one or two weeks. Special care of cough; if persisting, examine tonsils and adenoids; if necessary, send to dry high climate. Tonics and cod-liver oil. Great care in the following winter.

CHAPTER XL.**RUBELLA.**

(*German Measles. Röteln. Rubeola.*)

A mild, acute, specific infection characterized by a rose-pink papular or macular eruption, appearing early, by enlarged glands in the neck, and slight constitutional disturbance. A distinct disease, neither measles nor scarlet fever protecting against it.

Mode of Infection.—By direct contact. Moderately infectious. Adults often attacked. Second attacks extremely rare.

Duration of Infectivity.—Seven days after temperature normal. Infectivity apparently commences two or three days before symptoms.

Quarantine Period for Contacts.—Twenty-one days.

Symptoms.—

INCUBATION PERIOD.—Fourteen to twenty-one days: rarely up to twenty-nine days.

ONSET.—Slight malaise, headache, conjunctivitis, and pyrexia.

RASH.—Often the earliest symptom, rarely later than second day.

DISTRIBUTION.—Commences on face, or face, trunk, and arms simultaneously. Spreads to lower extremities in twenty-four hours; often fading from face. Rarely, face free.

CHARACTER.—Discrete numerous rose-pink spots; on trunk and limbs often coalesce rapidly, becoming indistinguishable here from scarlet fever. Occasionally macules form, but smaller than measles.

DURATION.—One to two days, rarely three: disappears from feet last. Leaves slight stain: desquamation rare and slight.

OCCIPITAL GLANDS.—Enlarged: less constantly, also posterior cervical and mastoid. Never suppurate.

CONSTITUTIONAL SYMPTOMS.—Mild. (1) *Fauces*: dryness and slight redness. May be rash on soft palate. (2) *Temperature*: often normal: may rise to 104° for one or two days.

BLOOD.—Often many varieties of mononuclear cells, especially type known as 'plasma' cells.

Complications.—Rare. Mortality negligible.

Diagnosis.—From:—

SCARLET FEVER.—Rash may simulate scarlet fever on second day when faded from face and coalescent on trunk, but remains discrete on feet; constitutional symptoms slight; no circumoral pallor; no peeling.

MEASLES.—No coryza, prodromal symptoms, or bronchitis; conjunctivitis slight; rash is brighter tint.

GLANDULAR FEVER.—Rash may be indistinguishable.

Treatment.—No special treatment necessary.

'Fourth Disease'.—As described by Dukes, this is not accepted. But a harmless acute infectious erythema probably exists which is not rubella, measles, or scarlet fever.

CHAPTER XLI.

MUMPS.

(*Epidemic Parotitis.*)

An acute specific infection, characterized by swelling of the salivary glands, especially the parotids.

Etiology.—Widespread. Endemic in most towns. Large epidemics common.

AGE.—Mainly five to fifteen years: infants rare: adults not immune. Boys specially liable.

SEASON.—Prevalent in winter and spring.

Morbid Anatomy.—Changes mainly inflammatory in connective tissue of glands, and but slightly affecting parenchyma.

Mode of Infection.—By direct contact, spread by droplets of saliva: exposure often very short. One attack protects.

VIRUS unknown. From the occurrence of orchitis, pancreatitis, etc., it appears to attack certain glands, with special predilection for the parotids.

Duration of Infectivity.—Isolate for three weeks from enlargement of glands. Must be one week after swelling subsides.

Quarantine Period for Contacts.—Twenty-six days. No infection from a contact up to seven days.

Symptoms.—

INCUBATION PERIOD.—Twelve to twenty-five days, rarely thirty. Usually eighteen to twenty-two days.

PRODROMAL.—Malaise for one to two days: often absent.

PAROTID GLAND.—Swelling and tenderness, commences *behind jaw and behind ear*, lifting the lobe of the ear: *spreads forward over jaw and down neck* beneath sternomastoid; doughy: skin

Mumps—Symptoms, continued.

may be red; pain on opening mouth, varies with degree of swelling and tension. When severe, oedema of neck and enlarged cervical glands. *Unilateral at onset*; other side usually follows in one to five days. Facial nerve is never affected.

SUBMAXILLARY GLANDS.—Usually enlarged: occasionally without parotid enlargement. *Lingual glands* less often.

TEMPERATURE.—About 101°.

BLOOD.—Initial leucopenia; returns to normal in few days. Lymphocytosis and monocytosis develop to moderate degree; may be marked in children.

LYMPHATIC GLANDS.—Rarely enlarged.

DURATION.—Glands attain maximum in three to four days: subside in seven to ten days. Relapses rare.

Complications.—*Rare*, except orchitis, but sometimes severe.

1. **ORCHITIS.**—In 20 to 40 per cent, especially young adults. Onset about eighth day, with fever and malaise, swelling of one or both testes; occasionally urethral discharge. Duration three to five days. *Atrophy may follow*. In epidemics, cases of orchitis occasionally occur without parotitis. *Ovaritis* may occur: suggested by pain and tenderness in lower abdomen, and pyrexia.
2. **ENCEPHALOMYELITIS (*Encephalitis*).**—Rare. Onset during or even previous to parotitis. Pyrexia, headache, vomiting, and various nervous symptoms. Mortality low. Very rarely, permanent paralysis. Formerly known as 'cerebral mumps'.
3. **ACUTE PANCREATITIS.**—Pyrexia, epigastric pain, and abdominal discomfort. Rarely serious. Diabetes recorded.
4. **PAROTID GLANDS.**—Chronic hypertrophy. (Possibly connected with carious teeth or oral sepsis.)
5. **DEAFNESS.**—Rarely permanent. Otitis media rare.
6. **SUPPURATION OF GLANDS.**—Extremely rare.
7. **MASTITIS** occasionally occurs.

Various Rare Sequelæ.—Peripheral neuritis, paralyses, affections of special senses, nephritis.

Diagnosis.—Simple. A septic parotitis may occur in conditions when mouth becomes dry (*see INFLAMMATION OF THE SALIVARY GLANDS*). In glandular fever the salivary glands are not affected.

Prognosis.—Mortality practically confined to 'cerebral mumps'.

Treatment.—*Rest in bed* for ten days at least. Purgative. Mouth washes. *Diet*: jellies, custards, and semi-solids swallowed more easily than fluids. *Local to gland*: if very tender, hot or cold compresses as desired, sprinkled with tinct. opii; or paint with glycerin and belladonna, cover with cotton-wool. Leeches relieve great tension. *Orchitis*: rest in bed: wrap in cotton-wool and support testes. *Cerebral symptoms*: ice-cap to head.

CHAPTER XLII.

TYPHUS FEVERS.

The typhus group of diseases is caused by various strains of the virus *Rickettsia*. The group varies in clinical severity and in epidemiological and serological factors. The recognition of the non-epidemic forms is mainly due to the use of the Weil-Felix reaction.

Weil-Felix Reaction.—A bacillus of the proteus group, known as *Proteus* X 19, has been isolated from excreta of typhus patients: is not causal organism, but is agglutinated in high titre by serum of true typhus patients from about the fifth day: maximum from eighth to twenty-first day: positive about three months. A second strain, *Proteus* XK, now also in use. Priority for this reaction is due to W. J. Wilson (Belfast).

Provisional Classification.—Based on Megaw

EPIDEMIC TYPHUS ('True Typhus')—Conveyed from man to man by louse. Its classical type Virus: *Rickettsia prowazeki*. Weil-Felix reaction: positive to X 19, negative to XK.

NON-EPIDEMIC TYPHUS—Primarily diseases of lower animals, especially rodents, conveyed from them to man by bites of (1) ticks, (2) mites, and (3) fleas: never from man to man. Endemic and sporadic but never epidemic.

1. By Ticks.—Reservoir: rodents. Weil-Felix reaction: negative both to X 19 and XK. Types: (i) Rocky Mountain spotted fever; (ii) Indian, African, South American tick typhus; (iii) Marseilles fever.
2. By MITES.—Reservoir: rats and mice. Weil-Felix reaction: negative X 19, positive XK. Types: (i) Japanese river fever, (ii) Tropical 'scrub' typhus.
3. By FLEAS.—Reservoir: rats. Weil-Felix reaction: positive X 19, negative XK. Types: (i) Brill's disease; (ii) Tropical 'urban' typhus.

There is no recorded instance of non-epidemic typhus being conveyed from man to man. This is true even of Brill's disease (flea typhus), the mode of infection in which resembles plague, the symptomatology resembling true typhus: ascribed to fact that rats do not die of the disease and hence fleas do not migrate; also infection is transient.

I. TRUE TYPHUS FEVER.

§ An acute, highly contagious disease conveyed by louse, characterized by sudden onset, marked nervous symptoms and toxæmia, rash, and pyrexia, terminating by crisis about fourteenth day. Typhus and typhoid fever only distinguished in the 19th century.

Etiology.—Epidemics of enormous extent occur. Endemic in Russia and the Balkan States. Ireland has suffered heavily. Also in Mexico and Eastern States of America. Principally in temperate

True Typhus Fever—Etiology, continued.

regions. War, famine, poverty, and dirt favour outbreaks. Spreads more rapidly than any of the other great epidemic diseases; mortality among attendants is high.

Morbid Anatomy.—Ordinary changes of acute fever present. *Typhus nodules* in skin, brain, etc.: formed by localized necrosis of walls of smaller blood-vessels, with lymphocytes and plasma-cells in adventitia. Rash is visible after death.

Mode of Infection.—From man to man by body or head lice: never water-borne or air-borne.

Blood infective in febrile stages, also shortly before and after.

Lice most infective five to seven days after feeding, and hence probably some development occurs. Transmitted from excreta of gut scratched into skin, and not by bite. Infection is transmitted through eggs, and second generation of lice can convey infection.

Monkeys and guinea-pigs can be infected.

Epidemics can be controlled by measures directed against lice.

VIRUS.—*Rickettsia prowazeki*: occur as minute intracellular bodies in stomachs of typhus-fed lice and in blood of typhus patients (rare). Has been cultured.

SERUM from convalescent patients is protective for a short time, but has no curative power.

WEIL-FELIX REACTION.—Positive to *Proteus* X 19, negative to XK.

Prophylactic Inoculation.—Under trial in Russia with inactivated typhus blood.

Duration of Infectivity.—Four weeks from onset.

Quarantine Period.—Fifteen days.

Symptoms.

INCUBATION PERIOD.—Usually about twelve days, but very variable. Limits five to fourteen days: possibly three weeks. Occasionally slight malaise for a day or two.

CLINICAL STAGES.—(1) Invasion, first to fifth day; (2) Nervous excitement and eruption, fifth to tenth day; (3) Nervous prostration, tenth to fourteenth day; (4) Crisis.

1. Stage of Invasion.

ONSET.—Abrupt.

RIGORS.—Common. Chills may recur in 24 hours.

PAINS.—In back and legs, especially thighs.

HEADACHE AND NAUSEA.—Vomiting not uncommon.

MENTAL SYMPTOMS.—Onset early, commence with sleeplessness. *Early prostration.*

EXPRESSION.—Dull, becoming vacant. Face flushed, with earthy hue (*facies typhosa*).

TEMPERATURE.—High at onset, rises steadily to maximum on fifth day.

Pulse rapid; tongue furred; constipation; bronchial catarrh.

2. Stage of Nervous Excitement and of Eruption.—Fifth to tenth day. Characterized by restlessness, rash, and delirium.

RASH.—*Onset*: Usually fourth to fifth day. Commences in axillæ and, on wrist, then abdomen: spreads to chest and extremities. Rare on face and neck.

Character: two elements.

- i. Subcuticular mottling, diffuse, irregular, and dusky.
- ii. Papular spots. Very irregular size and shape, and indefinite outline. Slightly elevated. Pink or dusky colour. In early stages, disappear on pressure; later, some spots become petechial, *resembling flea-bites*. Usually very numerous. Continue to appear for two or three days. (In children, close resemblance to measles, owing to coalescence of spots into blotches.) Rash has so-called 'mulberry' appearance.

DELIRIUM.—Replaces headache towards end of first week; most marked at night. Often restless, alert, and very violent: in other cases comatose.

ODOUR.—May be distinctive, suggesting mice.

Prostration increases, tongue dry, sordes. Temperature high, 105°. Pulse rapid.

3. Stage of Nervous Prostration.—Tenth to fourteenth day.

Extreme nervous prostration, incoherence, stupor, passing to unconsciousness and coma; muscular tremors, *subsultus tendinum*, and coma vigil common (adynamic typhus). The earlier the onset of this typhoid state the worse the prognosis.

RASH.—Darkens, and spots become petechial in centre, like remains of flea-bites. Duration of rash usually seven to ten days.

Cardiac weakness frequent. Pulse rapid and soft. Tongue dry and shrivelled. Sordes. Deafness.

In severe cases pin-hole pupils and 'ferret' eyes. Incontinence. Hiccup serious.

In unfavourable cases: (1) Coma vigil: vacant gaze, open eyes, dilated pupils, complete unconsciousness; practically always fatal. (2) Hypostatic congestion of lungs. (3) General exhaustion and cardiac failure; crisis and recovery very frequent.

4. Crisis.—Most often on fourteenth day. Patient falls asleep, and wakes extremely weak, but conscious; temperature drops in a few hours; symptoms clear; convalescence rapid. Relapse never. Abatement may occur by lysis.

5. Special Features.—

TEMPERATURE.—First to fifth day, rises steadily, slight morning remissions: maximum fifth day, 103° to 106°. No fall with appearance of rash. Slight morning remissions until crisis. Crisis, temperature falls to subnormal in twelve to twenty-four hours. In fatal cases rises to 108° or 109°.

True Typhus Fever—Special Features, *continued*.

LUNGS.—Bronchial catarrh early. Hypostatic pneumonia later.

Pulmonary complications have high mortality.

HEART.—Pulse often rapid and feeble throughout. Rarely dicrotic.

Systolic murmur common. Dilatation and failure not infrequent.

URINE.—Albuminuria common. Nephritis rare.

BLOOD.—Leucocytosis usual.

SPLEEN.—Rarely and transiently palpable.

WASSERMANN REACTION.—Positive before crisis.

Variations in Type.—Mild cases occur, with convalescence on tenth day, especially in children: blood infective. Malignant forms, *typhus siderans*, fatal in two or three days.

Complications and Sequelæ.—Uncommon. Bronchopneumonia most frequent: is serious, may end in gangrene of lungs. Rare are: nephritis, abscesses, gangrene, paralyse. May be temporary mania.

Prognosis.—General mortality 12 to 20 per cent, but varies greatly with treatment, age, and in different epidemics and surroundings. Varies directly with age. In children 2 to 4 per cent; after 40 years over 50 per cent. Death most frequently in second week from toxæmia: in third week from pulmonary causes.

Diagnosis.—In epidemics is simple. Difficulties usually in first few days before eruption. Weil-Felix reaction (p. 269) of great value.

1. **TYPHOID.**—In typhus: sudden onset, rigor, early prostration and mental symptoms, with absence of diarrhoea, abdominal tenderness, and enlarged spleen; aspect dull; character of rash distinctive, but not invariably. Cultures and Widal negative. Diagnosis often very difficult.
2. **MEASLES.**—Catarrhal symptoms. Koplik spots. Rash brighter, edges more defined, marked on face.
3. **CEREBROSPINAL FEVER.**—Cerebrospinal fluid distinctive.
4. **PURPURA.**—Common mistake in sporadic cases.
5. **FLEA-BITES.**—May resemble petechiæ in later stages of rash.
6. **SEVERE SMALL-POX.**—Difficulty from initial scarlatinal rash. True rash affects face early.
7. **RELAPSING FEVER.**—Examination of the blood.

Treatment.—In general resembles typhoid fever. Diet not so strict. Should be in open air if possible. Delirious stages need constant watching; hydrotherapy of great assistance. Give water freely. Drugs only as cardiac stimulants or sedatives. Retention of urine may need catheterization. In convalescence, restrain patient's anxiety for exertion.

II. ROCKY MOUNTAIN FEVER.

An acute infective, endemic fever of the typhus group, conveyed by bites of a tick, resembling epidemic typhus in fever, constitutional disturbances, and petechial eruption.

Distribution.—Montana and Idaho. Also in other Western and Pacific States. Commonest in spring months.

Epidemiology.—*Reservoir*: rodents, especially ground squirrels and woodchucks. *Vector*: *Dermacentor venustus* (tick). *Virus*: *Rickettsia rickettsii*. *Weil-Felix reaction*: negative to X 19 and XK (positive to some strains). Domestic animals, bears, etc., are hosts of ticks, but are not infected. One attack protects.

Symptoms.—

INCUBATION PERIOD.—Three to twelve days.

ONSET.—Sudden: rigor, general pains. Temperature high by second day.

ERUPTION.—On third to fifth day. Commences at wrists: extends to trunk and limbs: face mainly escapes. At onset: pink macules disappearing on pressure: becomes petechial: may be discrete or confluent.

IN SECOND WEEK.—Temperature high. Pulse rapid. Spleen may be palpable and tender. Typhoidal state in severe cases.

AT BEGINNING OF THIRD WEEK.—Temperature begins to fall and rash to fade. Normal temperature and convalescence in fourth week.

Constipation usual. May be vomiting in second week. Slight leucocytosis.

Complications.—Gangrene may follow.

Prognosis.—Depends on nervous symptoms and not on degree of rash. Mortality high in Montana. Varies in localities.

Diagnosis.—From measles and cerebrospinal fever.

Treatment.—No specific treatment.

Indian Tick Fever.—Resembles above. *Reservoir*: rodents of the wilds. *Vector*: *Rhipicephalus sanguineus* (tick).

III. JAPANESE RIVER FEVER.

(*Tsutsugamushi Fever*.)

An acute infective, endemic fever of the typhus group, conveyed by the bite of a mite. Characterized by a local eschar, followed by inflammation of lymphatic glands, fever, and a typhus-like eruption.

Distribution.—Originally recognized on river banks in Japan. Now known to have wide distribution. Tropical 'scrub' typhus and Mosman river fever (Queensland) may be identical.

Epidemiology.—*Reservoir*: rats and mice. *Vector*: a mite, larva of *Trombicula akamushi*. *Virus*: *Rickettsia orientalis*. *Weil-Felix reaction*: negative to X 19, positive to XK. One attack does not protect.

Symptoms.—At site of bite, black eschar with red areola forms: separates about fourth week, leaving ulcer.

INCUBATION PERIOD.—Five days to two or three weeks. Then lymphatic glands draining area of eschar become enlarged and tender, temperature rises rapidly, with rigors and general malaise.

ERUPTION on fourth to seventh day: red macules fading on pressure and later becoming petechial: commences on trunk and extends to limbs: face may be affected. Lasts four to seven days.

Japanese River Fever—Symptoms, continued.

With eruption, general symptoms increase: excitement and delirium. Conjunctivitis and bronchitis severe. Abdominal discomfort and constipation. Spleen may be palpable. Leucopenia distinct. Temperature falls after 2 to 3 weeks and convalescence commences.

Prognosis.—Serious. Mortality in Japan 20 to 50 per cent.

Diagnosis.—From plague.

IV. BRILL'S DISEASE.

(*Flea Typhus.*)

Is probably a mild form of true typhus, virus possibly being a modified strain. Protective cross-immunity with louse typhus.

Distribution.—World-wide. Originally recognized in New York. Tropical 'urban' typhus is identical.

Epidemiology.—*Reservoir*: rats. *Vector*: rat fleas, *Xenopsylla astia* and *cheopis*. *Weil-Felix reaction*: positive to X 19, negative to XK.

Symptoms.—As in true typhus, but milder.

Treatment.—Symptomatic.

CHAPTER XLIII.**DENGUE.**

A specific infectious fever, lasting six or seven days, due to an unknown virus conveyed by mosquitoes, and characterized by severe pains, an initial fever, a remission, and a terminal fever and eruption.

Geographical Distribution.—In tropics and subtropics only. Mainly a coast disease, following trade routes.

Mode of Transmission.—Note:—

- a. Virus unknown. Filter passer. Patient's blood is infectious one day before and first three days of fever.
- b. Mosquito conveys virus: *Aedes ægypti*: becomes infectious eleven days after biting, and remains infectious for life. Occurs in epidemics, affecting great percentage of population. Not contagious from man to man. One attack usually protects.

Symptoms.—

INCUBATION PERIOD.—Variable: probably five to nine days.

INITIAL FEVER.—Sudden onset: chill, severe headache and aching of eyeballs, *intense pains in joints and muscles*. *Temperature* 103° to 106°, often maximum on first day. *Pulse* rapid: usual febrile symptoms. *Face* suffused, often swollen; mucous membranes congested, causing sore mouth and conjunctivitis;

skin erythematous; this general condition forming so-called *initial eruption*. Nausea and vomiting not uncommon (may be severe).

PERIOD OF REMISSION.—Between second and fifth day (often third) temperature falls, with sweating, cessation of pains in joints, and of headache, epistaxis often occurring: congestion disappears. May occur by crisis or less rapidly. Duration two to three days.

TERMINAL FEVER AND ERUPTION.—Fever and pains recur, usually milder than initial stage; duration twenty-four to thirty-six hours. *Eruption*: rarely absent; earliest on palm and back of hands: later on trunk, thighs, and legs. Commences as reddish, erythematous areas, fading on pressure, finally may coalesce; but varies in different epidemics, resembling measles or scarlet fever, and is not characteristic in type. Often persists several days. *Miliary desquamation* follows. Pulse often very slow. Leucopenia.

TOTAL DURATION.—Usually seven to eight days.

CHARACTER OF PAINS.—Great severity. *Knees most constant site, also back*, but none immune. Localization of pain very difficult and cause uncertain: joint is not swollen, and can be palpated or moved passively without discomfort, but intense pain follows movement by patient: nor are muscles tender, though probably are cause of pain. (Some observers have recorded swollen joints and hyperæsthesia: absent in most epidemics.)

CONVALESCENCE.—Protracted, from mental and physical weakness. Pains in one or more joints often occur intermittently for weeks.

Complications.—Rare. Cervical glands may be enlarged. Rarely hæmorrhages, orchitis, boils.

Varieties.—Temperature typically shows 'saddle-back' curve. Inoculation experiments prove temperature may be continuous for 5 or 7 days, explaining certain 'five-day' and 'seven-day' fevers of tropics.

Mortality.—Direct mortality nil. Debility resulting may predispose to diarrhœa, etc.

Diagnosis.—In epidemics simple. Main symptoms are intensity of pains, period of remission, and terminal eruption. Diagnosis from:—

INFLUENZA.—Occurs in cold seasons.

MALARIA.—Not epidemic. Protozoa in blood. Controlled by quinine.

YELLOW FEVER.—Jaundice, hæmorrhages.

RHEUMATIC FEVER.—Not epidemic; effect of salicylates.

Treatment.—Symptomatic. Quinine has no special effect. For hyperpyrexia, hydrotherapy. Pain often requires morphia. Purges to be avoided if possible, owing to the pain of frequent motions. In convalescence, tonics.

Prophylaxis.—Anti-mosquito precautions.

CHAPTER XLIV.

ACUTE POLIOMYELITIS.

(Heine-Medin Disease. *Polio-encephalitis. Infantile Paralysis.*)

An acute infection localized in the central nervous system, resulting especially in lesions of the anterior horns of the spinal cord, and characterized by fever and paralyses.

History.—VON HEINE, 1840, recognized the clinical entity. MEDIN, 1887, observed its occurrence in epidemics.

Distribution.—Widespread in temperate climates, throughout Europe and North America. Sporadic cases common. Epidemics may be extensive.

SEASON.—Late summer and autumn, greatest prevalence. Epidemics diminish with cool weather.

AGE.—Great majority *under five years*. Frequency diminishes rapidly subsequently, but adults not immune, and specially affected in some epidemics.

SEX.—Both sexes.

Mode of Infection.—

LANDSTEINER and POPPER, 1909: transmitted disease to monkey by intraperitoneal injection of spinal-cord tissue from a fatal case. FLEXNER, 1909: results more constant by intracerebral injections. FLEXNER and LEWIS, 1911: (1) Transmission to monkeys by injection of nasal mucosa of patients; (2) Transmission from one monkey to another.

PATHS OF EXPERIMENTAL TRANSMISSION.—(i) Intracerebral and subdural; (ii) Large nerve trunks (paralysis commences locally); (iii) Nasal mucosa, scarification and inoculation with virus or by simple injection into nasal cavities; (iv) Intravenous, very large injections necessary. *Note:* If nerve supply is divided proximal to site of inoculation, no symptoms develop.

ANIMALS SUSCEPTIBLE.—Anthropoid apes and lower monkeys.

THE VIRUS.—

1. Filterable through earthenware filters. Ultra-microscopic.
2. *Distribution in Tissues.*—Present in: (a) Nasal mucosa (even after intracerebral injection); (b) Nervous tissue. Absent from blood, cerebrospinal fluid, and solid organs.
3. '*Globoid Bodies*'.—Infective nerve tissue cultured anaerobically in Noguchi's medium (ascitic fluid containing rabbit's kidney) shows opalescence on fifth day containing '*globoid bodies*': identity with virus not proved.

SERUM.—After infection, antibodies present for many years:—

1. Neutralize virus when mixed *in vitro*.
2. Intraspinal injection into monkeys before or shortly after inoculation with virus usually protects.
3. Human adult serum contains antibodies in 80 per cent: suggests (but does not prove) previous infection without symptoms.

NATURAL MODES OF INFECTION.—Through nasal mucosa (droplet infection). Extension in epidemic erratic, as in cerebrospinal meningitis, factors probably being: (1) Many persons non-susceptible (*see* SERUM); (2) Healthy contacts act as carriers: infectivity probably for 2 to 3 weeks only; (3) In stage of paralysis, probably non-infectious. *One attack protects* (as in virus infections).

Path of Virus.—Disputed, but following explanation most generally accepted: Virus is strictly neurotropic, spreads along axis cylinders: there is no systemic infection, and nervous system is already involved at time of earliest constitutional symptoms.

Path may be regarded in following artificial divisions (Faber):—

1. Nasal mucosa, through olfactory nerves, bulb, and tract to hypothalamus and thalamus. Virus in thalamus produces constitutional symptoms and general hyperæsthesia of 'pre-paralytic' stage.
2. From brain-stem, through spinothalamic tract to posterior horns of cord and posterior-root ganglia. Here produces localized pains.
3. From last to anterior-horn cells: characteristic paralysis.

Virus at any stage may die out (abortive forms) or become localized, producing various clinical types.

Other authorities support a general systemic infection, thus explaining constitutional symptoms, and their occurrence in absence of obvious paralysis. Thence virus spreads to meninges, and by the vessels into the cord: the vascular lesions resulting in injury to the anterior horns.

Morbid Anatomy.—Changes in the nervous system are widespread, a polio-myelo-encephalitis, always more extensive than clinical symptoms suggest: thus, in fatal cases with paralysis of limbs, lesions are present in bulb and often in cerebral hemispheres.

Lumbar and cervical swellings of the cord most affected.

SPINAL CORD.—In anterior horn, and to less extent in Clarke's column and posterior horn, ganglion cells show degeneration and necrosis; foci of lymphocytes and polynuclear leucocytes, phagocytosis active. *Blood-vessels:* hyperæmia, perivascular 'cuffing' with lymphocytes; hæmorrhages, thrombosis, and rupture. *Interstitial tissues:* foci of cells. *Meninges:* congested.

BRAIN-STEM.—Similar but slighter changes.

The extensive initial paralysis is due to nerve-cells temporarily paralysed but recoverable; the lesser permanent paralysis is due to nerve-cells destroyed.

Cerebrospinal Fluid.—*Early stage:* Clear; pressure raised; cells increased, polynuclear leucocytes usually predominate; protein somewhat raised. *Later:* Cells mainly lymphocytes; protein very high. *Throughout:* Sugar and chlorides normal; fine coagulum on standing. Normal in three weeks. Virus absent.

Blood.—Polynuclear leucocytosis: about 25,000 per c.mm.

Symptoms.—

INCUBATION PERIOD.—Doubtful, probably five to ten days.

Acute Poliomyelitis—Symptoms, continued.

PREPARALYTIC STAGE.—Sudden onset. Fever, headache, irritable, face flushed, vomiting; may be general hyperæsthesia, stiffness of neck and back, slight involuntary movements of fingers. Duration: one to three days.

STAGE OF PARALYSIS.—Sudden onset. Characteristics: (1) Degree of paralysis maximum at onset—i.e., all subsequent change is improvement; (2) Paralysis is flaccid; (3) Distribution often asymmetrical—e.g., one leg and opposite arm.

Cutaneous sensation: Normal.

Reflexes: Absent in affected limbs.

Sphincters: Unaffected.

Pain: Unusual; may be severe. General hyperæsthesia ceases at onset of paralysis.

DURATION.—About three weeks. By this time extent of the paralysis usually much diminished: reflexes may be returning.

STAGE OF RECOVERY. Recovery of movement may continue for three months.

DISTRIBUTION OF LESIONS.—Most common is one leg: next one leg and one arm. In lower extremity, extensors of hip, knee, and dorsiflexors of ankle are most affected: and in upper extremity, muscles of the shoulder. Abdominal muscles not uncommonly in young children. Marked paralysis of trunk muscles rare, but may be sufficient to produce scoliosis during subsequent growth.

Course and Permanent Results.—All permanent paralysis is flaccid. During stage of recovery and as child grows, permanent results become obvious: (1) *Small size* and 'shortening' of affected limb (bones do not grow if many attached muscles are paralysed); (2) *Deformities*, especially talipes, flexed knee, occasionally scoliosis, lordosis, mainly from action of unopposed muscles; (3) Muscles wasted; (4) Vasomotor changes. Skin usually cold.

Clinical Types.—The disease may be localized at various sites, on which authorities disagree.

1. **SPINAL FORM.**—Usual type as described above.

2. **CEREBRAL FORM** (*Acute Encephalitis*).—Sudden onset of fever, vomiting, and convulsions, with paralysis, hemiplegic or monoplegic, of cerebral type. Residual paralysis remains. Occasionally mental defect or epileptiform convulsions.

3. **CEREBELLAR FORM.**—With symptoms of acute cerebellar ataxia. Complete recovery usual.

4. **MENINGITIC FORM.**—Resembles cerebrospinal meningitis. Cerebrospinal fluid: cells increased, but sugar normal and fluid sterile; cells at onset polynuclears, changing to lymphocytes in few hours.

5. **BRAIN-STEM FORM** (Medulla, pons, and mid-brain).—Bulbar, facial, ocular, and other palsies.

6. **ABORTIVE FORMS.**—No paralysis. Recognized in epidemics only.

Other forms are described but are doubtful—e.g., rapid, ascending, and neuritic types.

Prognosis.—

ACUTE STAGE.—Mortality varies in different epidemics, 10 to 20 per cent; deaths result from respiratory paralysis, either directly, or secondarily from bronchopneumonia; hence rare when these muscles are unaffected, and usually within first few days.

RECOVERY OF POWER.—

1. Severity of 'preparalytic' stage is no guide to amount of permanent paralysis.
2. Complete recovery is rare.
3. Initial paralysis is maximal.
4. Recovery of muscular power may continue up to three months. Further improvement is due to training of muscles.
5. Any return of reflex, superficial or deep, in early stages suggests recovery in muscles concerned.
6. If faradic response is present within three weeks, muscles will recover.
7. If reaction of degeneration present in muscles, *prognosis serious*. The sequel may be: (a) Gradually complete loss of galvanic response, denoting permanent paralysis; (b) Slow return towards normal response, showing possibility of improvement.

Diagnosis.—Difficulties occur mainly in infants, in cases with hyperæsthesia, and in abnormal forms: ordinary type simple.

In Acute Stage, diagnosis from:—

1. CONDITIONS WITH PAIN IN LIMBS simulating paralysis, e.g., *scurvy rickets* (a painful swelling), *rickets* (other signs present), *rheumatic fever* (never under two years), syphilitic epiphysitis, osteomyelitis.
2. MENINGITIS AND ENCEPHALITIS.—By: (a) Cerebrospinal fluid; (b) No early flaccid paralysis.
3. MULTIPLE PERIPHERAL NEURITIS.—May be difficult. Onset gradual: distribution symmetrical: some sensory changes.

In Stage of Residual Paralysis.—In central palsies, reflexes are spastic and reaction of degeneration absent: wasting and lack of growth may be present.

Prophylaxis.—Patients should be isolated for six weeks. Virus not present longer except in rare chronic carriers.

CLOSURE OF BOARDING SCHOOLS.—No dogmatic rule possible: knowledge of infectivity and mode of spread too deficient. Depends partly on home surroundings of children and possibility of sufficient isolation. Closure after a second case is reasonable and has been satisfactory.

Treatment.—

ACUTE STAGE.—*Complete rest is essential, and no electrical or other active treatment is to be attempted at this stage.* No drug is known to act upon the virus. Treatment as for any acute fever. Retention of urine may occur. Special measures in use are: (1) *Affected limbs*: wrap in cotton-wool. For pain: immobilization, aspirin. (2) *Lumbar puncture*; fluid often under tension. Hexamine: no effect.

Acute Poliomyelitis—Treatment, continued.

SERUM FROM CONVALESCENT PATIENTS.—Statistics inconclusive. Useless after 24 hours' paralysis. Inject 20 c.c. intrathecally.

PARALYSED MUSCLES.—*Essential principle*: Paralysed muscles must be kept in position of relaxation and never be allowed to be stretched, actively or passively. Limbs kept at rest and in position for three weeks by pillows, sandbags, and celluloid splints. Stretching may result from: (i) Gravity, e.g., drop-foot when lying in bed; (ii) Overaction of unopposed muscles; (iii) Limb placed in wrong position. This principle is of greatest importance. Subsequent treatment is: (1) Massage, light effleurage. (2) *Passive movements*, patient also to attempt movements daily. (3) *Electricity*, galvanic current.

SURGICAL TREATMENT.—Often necessary later, especially tenotomies, and transplantation of tendons.

CHAPTER XLV.

ENCEPHALITIS LETHARGICA.

(*Epidemic Encephalitis.*)

An acute specific disease of the nervous system, originally recognized by the syndrome of fever, lethargy, and ocular palsy. Symptoms now recognized to be protean.

In epidemic form, appeared in Austria in winter of 1916, in France and Great Britain in winter of 1917, and in America in winter of 1918.

Morbid Anatomy of Nervous System.—

MACROSCOPIC.—Congestion of meningeal and intracerebral capillaries. On section of brain gray matter reddened, minute vessels distended and oozing: these changes may be slight. Hæmorrhages are rare, but occasionally are large. White matter normal.

HISTOLOGY.—Gray Matter:—

1. Vascular congestion.
2. Small round-cell infiltration of the perivascular lymph spaces. This so-called 'perivascular cuffing' is the most constant change, but is often patchy in distribution. Cells are mainly small lymphocytes with a few large lymphocytes laden with pigment granules. General cellular infiltration. No demyelination.

Other less constant or marked changes include: (3) Degeneration in the nerve-cells and neuronophagy; (4) Proliferation of the mesoblastic cells of the vessel walls; (5) Glial proliferation; (6) Venous thrombosis; (7) Hæmorrhages.

DISTRIBUTION OF LESIONS.—Mid-brain, basal ganglia, and substantia nigra most affected. Any portion of nervous system or meninges may be affected.

Etiology and Mode of Infection.—

VIRUS.—Unknown. Believed to be filterable virus. Transmission to monkeys by intracerebral inoculation. Relation suggested to virus of herpes simplex (*not* zoster).

MODE OF INFECTION.—Evidence of direct contagion rare, but small outbreaks occur in institutions. Infection probably through nasal mucous membrane from carriers.

DURATION OF INFECTION.—Unknown. Evidence suggests that the virus returns to activity, as in syphilis, after intervals of quiescence.

AGE.—No age immune, but rare in very young children.

SEASON.—In British Isles, apparently seasonal prevalence; maximum in March and minimum in November.

Incubation Period.—Uncertain. Probably about two weeks.

Symptoms.—Originally recognized by syndrome: fever, lethargy, and double vision. These cardinal symptoms still occur in most cases at some time in course.

CLASSIFICATION.—Classification of cases is very difficult. Many 'types' are described, but a single case may correspond to many types at different times in its progress; for Economo's types, see p. 284. The symptoms are very varied and complex owing to widespread lesions. They will be classified as follows (based on Walshe):—

GENERAL SYMPTOMS.

NERVOUS SYMPTOMS.—(1) General: (a) Negative; (b) Positive. (2) Focal: (a) Negative; (b) Positive. Negative symptoms denote depression or loss of function from destruction of nervous tissue. Positive symptoms denote exaltation of function, either from irritation or from loss of higher control.

MODES OF ONSET.—

1. **INSIDIOUS.**—Most frequent; with or without general initial symptoms.
2. **ACUTE.**—May be extremely sudden. Symptoms usually distinctly of positive type—e.g., acute delirium, convulsions, or severe muscular pain—but may be rapid lethargy.
3. **MILD ABORTIVE TYPES, OR FORMES FRUSTES.**—Symptoms may suggest influenza; nervous symptoms slight or absent. Any sequelæ may develop later: initial attack may be unrecognized.

GENERAL AND INITIAL SYMPTOMS.—Headache (especially occipital), vertigo, shivering, general weakness, constipation, vomiting, and other gastro-intestinal disturbances common but not severe. No typical rash, but may be erythemata. Temperature variable: at onset may be 102° to 105°, rarely more than few days, or may be absent (*see below*). Severity of these symptoms variable; may be mild: not closely related to degree of nervous-system involvement.

NOTE.—Cardinal symptoms, lethargy and diplopia, often present from onset. As course progresses, 'Parkinsonian mask' develops. *Any of the nervous symptoms or so-called 'late manifestations' and 'residua' may develop from the onset.*

Encephalitis Lethargica—Symptoms, *continued*.

NERVOUS SYMPTOMS.—

1. GENERAL.—

- a. *Negative*.—Lethargy: all grades from apathy to coma.
- b. *Positive*.—Restlessness, delusions, delirium, mania; all serious. General convulsions: not common, but high mortality.

2. FOCAL.—

- a. *Negative*.—Represented by paralyses; no portion of nervous system immune:—

- i. Ocular palsies (most common).
- ii. Cranial nerves: facial palsy, pharyngeal and laryngeal muscular palsies with dysphagia, etc. Also phrenic nerve.
- iii. Aphasia, hemiplegia, and monoplegia of any variety. Any disease of nervous system may be temporarily simulated, e.g., disseminated sclerosis, myasthenia gravis, tabes.

- b. *Positive*.—(See EXTRA-PYRAMIDAL SYNDROMES.)

- i. Muscular pains: may be severe and in any site (probably of thalamic origin).
- ii. Rigidity (including Parkinsonian syndrome).
- iii. Involuntary movements and contractions.

Note.—'Positive' general and focal nervous symptoms are usually associated and commonly have an acute onset ('hyperkinetic type'). So, also, 'negative' symptoms are usually associated and have an insidious onset ('somnolent-ophthalmoplegic type'). But there is no absolute rule, nor limit to the combination of symptoms.

NOTES ON SPECIAL SYMPTOMS.—

- 1. LETHARGY.—Depth and duration very variable, but rarely absent throughout. At onset, may be merely drowsiness, but may be deep sleep (prognosis not always bad). Somnolence by day and insomnia by night not infrequent. When roused even from lethargy or deep sleep, may be mentally clear. Drowsiness deepening to stupor is serious.

Duration of lethargic state variable; few days to months, commonly 2 to 3 weeks. May be absent, and develop as a sequela.

- 2. DIPLOPIA AND OCULAR MANIFESTATIONS.—Ocular disorders present in most cases.

- i. *Diplopia*.—Cardinal feature in all epidemics: strabismus may not be obvious.

- ii. *Ptosis*.—Not uncommon.

- iii. *Pupil Reactions*.—All variations occur—e.g., reaction to light and not to accommodation, true Argyll Robertson, inequality, irregularity, contraction, or dilatation.

- iv. *Nystagmoid Movements*.—True nystagmus is rare.

Optic neuritis probably does not occur.

- 3. PARKINSONIAN MASK.—Rigidity and absence of slight automatic facial movements may develop acutely within week

or two of onset. Resembles, but not quite identical with, paralysis agitans. Tremors slight.

4. FEVER.—Variable. May be 102° or higher at onset, falling in few days. Or normal at onset and then rise. Steady rise is bad sign. Occasionally afebrile throughout.
5. REFLEXES.—No constant change. Deep reflexes usually increased. May be absent (and Argyll-Robertson pupil present). Babinski's sign rare.
6. CEREBROSPINAL FLUID.—Cell-count normal in at least one-third of cases. In about half, lymphocytosis present; number of cells usually under 50, and rarely as much as 100 per c.mm. Wassermann reaction negative.
7. BLOOD.—Leucocytosis common.

RESIDUAL AND LATE MANIFESTATIONS.—Note: (1) Any of these phenomena may be present from the onset, though occurring most frequently in late and convalescent stages. (2) Long intervals, on the other hand, may elapse between acute stage and their appearance. In interval, may be apparently complete recovery or some persistence of symptoms. (3) Acute stage may be very slight and unrecognized.

1. PARKINSONIAN SYNDROME.—(Lesions in substantia nigra.) Apart from presence at onset, develops most frequently 6 to 12 months after initial attack. Parkinsonian mask. Rigidity variable. Tremors unusual, but are rapid when present. Salivation common. Development is often rapid, but recovery may take place. Mental changes common when Parkinsonism marked, especially in children. Occurs especially between 15 and 35 years of age. *Catatonia* sometimes marked.

Oculogyral Spasms.—Attacks of spasmodic conjugate ocular deviation, usually upwards; last half-an-hour. Common recently.

2. CHANGES IN MENTALITY.—Of great importance. Exhibited in at least 75 per cent of cases. All grades, but certifiable insanity is rare.

- i. *Adults*.—Usually, lack of power of concentration, application, and initiative. May be persistent drowsiness or insomnia. Irritability sometimes, but excitement rare. Mental depression not common.

- ii. *Children*.—

Group 1: Lack of concentration and attention, as in adults. Child remains at same age.

Group 2: Characterized by excitement: especially under 10 years of age. Noisy and uncontrollable.

Special group: excitement nocturnal; during day tired and quiet.

Group 3: Moral changes. Perverted, cruel, dangerous, and sexual. Usually between 10 and 18 years. Family history often not good morally. Idiocy (usually under 5 years of age) and certifiable insanity rare.

Groups 2 and 3 are rare, but disposal is very difficult.

Encephalitis Lethargica—Residual and Late Manifestations, *continued*.

3. INVOLUNTARY MOVEMENTS AND MUSCULAR CONTRACTIONS: EXCITOMOTOR MANIFESTATIONS.—
 - i. *Choreiform and Athetoid Movements*.
 - ii. *Myoclonus*.—Rapid rhythmic contraction of muscles at rate of 30 or 40 a minute; affects single muscle or portion of muscle; occasionally widespread; most commonly abdominal muscles. May be no movements of joints. May develop months after initial attack, often mild and unrecognized: less often in acute stage, with severe neuralgic pains.
 - iii. Tics, tremors, slow rhythmic movements of all types.
4. DISTURBANCES OF RESPIRATORY MECHANISM.—Polypnoea may occur in initial attack: never persists, though prognosis serious (tetany). As sequelæ, *common and varied*: polypnoea, spasmodic cough, sniffing, respiratory tics: common in children with mental changes.
5. PARALYSIS.—Persistence is comparatively uncommon.
6. VARIOUS.—Numerous manifestations occasionally observed. Obesity, polyuria, and pituitary disturbances may be associated.

Classification of Types (Economo).—

A. ACUTE TYPES.—

1. Somnolent—ophthalmoplegic. Negative symptoms marked: e.g., somnolence and diplopia.
2. Hyperkinetic. Positive symptoms marked: insomnia and movements.
3. Amyostatic—hyperkinetic. Parkinsonism marked.
4. Cerebellar.
5. Bulbar.
6. Ophthalmoplegic.
7. Neuritic. Simulates fibrositis.
8. Mono-symptomatic—e.g., hiccup.

B. CHRONIC TYPES.—

1. Progressive Parkinsonian.
2. Mental.

All types may be combined.

Prognosis.—Good prognosis can never be given, owing to severe sequelæ following mild attacks and at long interval (may be 4 years).

Mortality.—Approximately 25 per cent die, 25 per cent recover completely, and 50 per cent have various residua, of which at least 25 per cent exhibit Parkinsonism (Hall).

Early and Acute Stages.—Prognosis bad with: (1) Severe positive symptoms, e.g., acute delirium; (2) High fever.

Lethargy.—Deep sleep and lethargy has not a bad prognosis. Bad with somnolence deepening to stupor.

Early myoclonic cases nearly all recover.

Outlook with mental changes very poor: recovery not more than partial and usually relapses.

Pregnancy aggravates sequelæ.

Diagnosis.—Often very difficult. Note mode of onset, fever, initial symptoms, and certain special symptoms, e.g., lethargy or excitement, ocular palsies, mask-like Parkinsonian facies (most constant symptoms). Diagnosis from and relations to :—

1. INFLUENZA.—Initial symptoms often mistaken for influenza. Diagnosis only when sequelæ appear.

2. ACUTE ANTERIOR POLIOMYELITIS (Heine-Medin's disease). Main differences (Symonds) :—

	HEINE-MEDIN.	ENCEPHALITIS LETHARGICA.
Age	Mainly under 20 years.	All ages.
Onset	Acute or subacute.	Often insidious.
Temperature	Highest at onset before paralysis.	Often highest later (variable in character).
Distribution of lesions	Spinal cord, most.	Mid-brain, most.
Involuntary movements	Absent.	Frequent, early or late.
Course	Brief.	Prolonged.
Cerebrospinal fluid ..	Lymphocytes; globulin increased.	Lymphocytes often absent—rarely numerous; globulin slight.
Microscopic hæmorrhages	Constant in cord.	Inconstant and inconspicuous.
Perivascular infiltration	Slight.	Constant.

3. MENINGITIS, CEREBROSPINAL AND TUBERCULOUS.—By cerebrospinal fluid.

4. SYPHILIS.—By Wassermann reaction and symptoms.

5. CEREBRAL HÆMORRHAGE.—Gross hæmorrhages may occur in encephalitis lethargica and diagnosis be impossible.

6. BOTULISM.—Usually several cases in household. No pyrexia.

7. ACUTE DISSEMINATED ENCEPHALOMYELITIS—(q.v.).

Treatment.—Palliative and symptomatic. Lumbar puncture of no obvious effect. Hexamine is often given. For Parkinsonism, injections of hyoscine hydrobromide gr. $\frac{1}{100}$: or tincture of stramonium ℥ xxx, t.d.s. and increasing. Intravenous injections of iodine under trial.

EPIDEMIC HICCUP.

Possibly a partial form of the 'myoclonic type' of encephalitis lethargica. Antispasmodics indicated, e.g., atropine, but treatment has little effect. Mortality low.

CHAPTER XLVI.

HYDROPHOBIA.

(Rabies. La Rage.)

An acute, fatal, specific disease of the nervous system due to an unknown virus communicated to man through the saliva of an animal.

Distribution.—Widespread. Common in Russia and France. Not uncommon in United States. Rare in Germany. Eradicated from Great Britain as a result of muzzling dogs. Australia free.

Hydrophobia—Distribution, *continued*.

ANIMALS.—All mammals susceptible to inoculation, also birds.

Dogs, wolves, and jackals most frequent naturally: cats, cattle, horses rarely. Propagation almost entirely by dogs: in Russia also by wolves.

Morbid Anatomy.—*Nervous system* only affected. Other organs normal.

MACROSCOPIC.—Congestion and minute hæmorrhages may be present.

HISTOLOGY.—Several lesions occur:—

1. *Babes's 'rabic tubercles'*.—Collections of round cells around the large cells of motor area in cord and bulb; chromatolysis and degeneration of the motor cells follow. Are not specific of rabies.
2. *Van Gehuchten and Nélis*, 1900.—In the peripheral ganglia of the central and sympathetic nervous systems, proliferation of endothelial cells occurs, destroying the nerve cells; final appearance not unlike sarcoma. *Method of examination*: remove plexiform ganglion of the vagus nerve; stain paraffin sections with hæmalum and eosin. Animal must be allowed to die of disease. *Value in diagnosis*: *Absence* of these changes *negatives rabies*: presence not quite conclusive, occurring rarely in old animals, but sufficient if symptoms suggestive.
3. '*Negri bodies*', 1903.—Bodies present within nerve cells, especially large cells of *cornu ammonis* (hippocampus major): shape and size variable, 1 to 25 μ . With Romanowski stains, are eosinophilic. With Giemsa, structure visible; within bodies are small granules.

Nature of Bodies.—Similar to inclusion bodies in other ultramicroscopic viruses.

Method of Examination (William and Lowden).—Make smear from brain tissue, fix, and stain with Giemsa.

Value in Diagnosis.—Are diagnostic.

The Virus.—Unknown filterable virus. Is neurotropic. Present in all nerve tissues, and in saliva, reaching latter through nerves. Destroyed by drying in fourteen to fifteen days, and by light and heat. Passes a coarse Berkefeld or Chamberland filter. Spreads from site of inoculation entirely by nerves and nerve tracts. Absent in blood and solid organs.

Mode of Transmission.—In street rabies, by saliva from bites or licks: cannot pass through unbroken skin.

Symptoms.—

INCUBATION AND FREQUENCY OF DISEASE vary with:—

AGE.—Shorter in children.

SITE OF INFECTION.—In order: (i) Face and head most severe, from richness of nerves and lacerated character of wounds; (ii) Hands; (iii) Other sites. Clothes protect considerably.

SEVERITY OF WOUNDS.—Punctures and extensive lacerations most serious.

ANIMAL.—In order: (i) Wolf—40 per cent bitten by wolves develop symptoms; (ii) Cat; (iii) Dog.

Frequency of disease after bites from rabid dogs: 16 per cent, if untreated.

INCUBATION PERIOD.—Most often forty to fifty days. Earliest twelve days. Rare after three months. Over a year unproved. No symptoms. Wounds heal naturally.

Three subsequent stages are distinguished: often ill defined, and develop rapidly.

PREMONITORY STAGE.—Site of bite often becomes irritable, with pains in its neighbourhood. Depression, desire for solitude, intolerance of loud sounds and similar stimuli, with periods of irritability. Attacks of great fear. Voice becomes husky, and difficulty in swallowing commences. Temperature and pulse slightly raised. *Duration*, one to two days.

STAGE OF EXCITEMENT.—Extreme irritability. Expression of terror.

SPASMS.—Great severity and pain. Evoked by any stimulus.

Larynx and respiratory muscles first affected. Laryngeal spasms especially caused by attempt to drink, by sight, or even mention, of water. Contractions of larynx may cause unusual noises. Often extreme dyspnoea. Later, spasms more general. *Saliva* abundant and viscid, cannot be swallowed and hangs from mouth. Between spasms, mentally clear. Maniacal attacks may occur, with attempts at biting.

Temperature, often up to 103°, rarely normal. *Pulse*, rapid.

Duration, one-and-a-half to three days.

STAGE OF PARALYSIS.—Paralysis spreads and spasms cease. Unconsciousness, cardiac failure, death. *Duration*, a few hours.

TOTAL DURATION.—Usually four to five days.

CLINICAL TYPES.—(1) Furious rabies as above; (2) Paralytic or dumb rabies. Latter is very rare in man. Stage of paralysis alone present. May occur with extensive bites. Diagnosis only possible by inoculation in animals: no Negri bodies. Possibly due to toxins. Common experimentally in animals.

Diagnosis.—

CLINICAL.—Usually simple in man. Diagnosis from:—

1. **TETANUS.**—Trismus; spasms not completely relaxed, nor specially evoked by water.

2. **ACUTE BULBAR PARALYSIS.**

3. **LYSSOPHOBIA, PSEUDOHYDROPHOBIA.**—In persons bitten by animals. Incubation period usually short. No temperature. Hysterical manifestations. Long duration.

PATHOLOGICAL.—(1) Negri bodies, *diagnostic*; (2) Van Gehuchten and Nélis' ganglionic changes; (3) Inoculation of brain or cord into animals.

EXAMINATION OF ANIMAL.—Suspected animals, whether having been bitten or not, should not be killed, but chained and watched. If the animal is alive in ten days the disease is not rabies. If it dies, perform autopsy (examination of cornu ammonis for Negri bodies), and inoculation of nervous tissue into other animals.

Hydrophobia, continued.

Prognosis.—Invariably fatal if symptoms develop. General mortality of cases bitten by dogs, 16 per cent (without inoculation). Efficient cauterization in 5 to 15 minutes halves mortality: of some, but slight, value after twenty-four hours.

RESULTS OF PASTEUR'S TREATMENT.—Mortality of all cases treated is less than 1 per cent. Early treatment important owing to occasional short incubation.

Prophylaxis.—Muzzling of dogs and destruction of stray dogs.

Treatment.—

WOUNDS.—Early and thorough treatment most important. Apply ligature within 30 minutes to cause bleeding; bathe; cauterize with fuming nitric acid.

INDICATIONS FOR INOCULATION.—All persons bitten or contaminated by saliva of rabid animals. If rabies doubtful, animal to be watched: decision as to commencing treatment depending on extent of wounds.

SYMPTOMATIC.—Palliative only. Avoid all stimuli. Opium and chloroform to ease spasms. Rectal injections.

Pasteur's Prophylactic Inoculation.—**BASIS.**—

1. 'Street virus' has practically a constant strength. Inoculation kills a rabbit in fifteen to sixteen days.
2. Virus is exalted by passage through successive rabbits, until finally it kills in five to six days—'virus fixé'. (By passage through monkeys, virus *per contra* becomes attenuated.)
3. Rabbit's cord loses virulence on drying, being innocuous after fifteen to sixteen days. Hence a series of cords can be prepared of varying virulence according to period of drying.
4. Rabbits can be protected against an otherwise fatal injection by previous inoculation with such a series of cords, commencing with the weakest.
5. During the long 'incubation period' in man, similar inoculation can be performed.

METHOD.—Lengths of rabbits' cords, killed with 'virus fixé' and dried, are emulsified in normal saline and injected subcutaneously. First cord usually 8 days dried; length of 2 or 3 mm. used for injection. Intensity and duration of the course varies with nature of bites (fifteen to twenty-one days).

Symptoms during course.—May be pains near bites; rarely an ascending paralysis, very rarely fatal, possibly anaphylactic, or from attenuated virus.

DURATION OF IMMUNITY.—In dogs, diminishes about 20 per cent in a year. In man, no information: a second bite should be treated again.

Note: Various modifications of Pasteur's method are in use.

Antirabic Serum.—Tizzoni and Centanni's, prepared by inoculating sheep with virus attenuated by peptic digestion (Italian method of immunization). The serum may be and often is employed in

addition to the Pasteur treatment, especially in severe cases. Is protective to animals.

Rabies in Dogs.—Two types:—

FURIOUS TYPE ('*Street rabies*').—Stages practically correspond to human type. Early change in disposition, alternate excitement and desire for solitude, with increasing excitement. Voice alters, bark ending in *high plaintive note*: very suggestive. *Progress*: difficulty in swallowing food, not specially marked in regard to water. *Furious stage*: dog attacks everything, usually *runs straight*, may travel great distance. Paralysis and death follow. *Duration*: four to five days.

PARALYTIC OR DUMB RABIES.—Rarer. Early changes in disposition as above. No fury. Paralysis commences in jaw muscles, lower jaw falls. Hence unable to bite, and less dangerous. Paralysis extends. Death in two to three days. Not uncommon in rabbits killed with 'virus fixé': also occurs in dogs in Turkey.

CHAPTER XLVII.

RHEUMATIC FEVER.

An acute infection of unknown origin, characterized by multiple arthritis, and the frequent occurrence of inflammation of the endocardium of the valves of the heart, with resulting cardiac lesions.

There are certain important differences between rheumatic fever in adults and children. The general description applies to adults except where expressly noted, and the peculiarities in childhood are given in a separate section. The adult type commences about the age of 14 years.

Etiology.—Knowledge of etiological factors very incomplete.

CLIMATE.—Universal, but especially in temperate climates. Prevalence highest in British Isles.

SEASON.—In London, maximum in October and November, minimum in February and March. Varies greatly in different countries. In America, maximum in March.

AGE.—Most frequent from 15 to 35 years. Also occurs in childhood, but rare under 5 years and never under 2.

SEX.—Males more common than females, except between 10 and 15 years.

HEREDITARY INFLUENCE.—Generally accepted: most marked in children.

PREDISPOSING CAUSES.—Environment important, e.g., bad hygienic surroundings; is commoner in hospital class. Damp and wet is a factor. Enlarged tonsils and adenoids are probably important. The rarity of rheumatic fever in France during the European War is noteworthy.

IMMUNITY.—One attack definitely predisposes to others.

Rheumatic Fever—Etiology, *continued*.

PRIMARY FACTOR.—Unknown. Prevalent views as follows are theoretical :—

1. **STREPTOCOCCAL INFECTION.**—Many features resemble such infections. *Against*: not present in blood cultures, or Aschoff's bodies, very rarely in joints; joints never suppurate.
2. **HYPERSENSITIVENESS TO STREPTOCOCCI.**—Streptococci present in tonsils, etc. Lesions are allergic. Explains repeated attacks.
3. **ULTRAMICROSCOPIC VIRUS.**

The diplococcus described by Poynton and Paine remains in dispute.

Morbid Anatomy.—Aschoff's nodes now accepted as essential lesion: present characteristically in myocardium. Are spindle-shaped 'submiliary' bodies, i.e., smaller than miliary tubercles. *Histology*: (1) General fibroblastic proliferation; (2) Aschoff's large endothelioid cells, one or more nuclei, scattered; (3) Lymphocytes and plasma cells—varying numbers, may be numerous; (4) Necrotic tissue often in centre. May be present as above several years after acute attack, but in old cases are replaced by fibrous tissue.

CHANGES IN VALVES.—As in 'endocarditis'.

JOINT CHANGES.—*Slight*. Synovial membrane may show hyperæmia.

Symptoms.—(Description applies to acute attack in an adult.)

PRELIMINARY SYMPTOMS.—Frequently none, but not uncommonly :—

SORE THROAT or acute tonsillitis. Often clears in a few days, and interval of perfect health up to two weeks may elapse.

IRREGULAR JOINT PAINS with slight malaise for a few days.

ONSET.—Abrupt. Chill but no rigor. Condition fully developed in twenty-four hours.

CHARACTERISTIC SYMPTOMS are: (1) *Joints* swollen and painful; (2) *Face flushed*; (3) *Profuse sweats* with very sour odour; even in absence of sweats the skin is moist, and in spite of pyrexia is never dry; (4) *Sore throat*; (5) *Temperature high*, 101° to 103°; (6) *Pulse* soft and rapid, 100 to 120. Ordinary febrile symptoms marked. Tongue furred and moist. Anorexia, constipation, febrile urine, thirst. Sudamina and milaria frequent. Mind clear. Pain may cause sleeplessness.

JOINT AFFECTION (Arthritis).—Characteristics are :—

MULTIPLE JOINTS affected: especially larger joints, often symmetrically. In severe attacks, many attacked simultaneously.

FREQUENCY OF INVOLVEMENT.—Order: (1) Knee, (2) ankle, (3) wrist, (4) elbow, (5) shoulder; vertebral, sternoclavicular, jaw, and phalangeal joints very rare.

INFLAMMATION.—Wanders from joint to joint, e.g., as knee recovers, wrists swell. Change may occur in twenty-four hours. In space of three or four days many joints may have been affected.

JOINTS.—Swollen, red, hot to the hand, tender, and extremely painful on movement. Changes are mainly inflammation of peri-articular tissues. The synovial membrane often palpable. Tissues are infiltrated with serum, but œdema and pitting of the skin on pressure is absent even in severe cases. Tendon sheaths involved. *Extensive effusion into joint rare.*

JOINT FLUID.—Turbid. Contains numerous polynuclear leucocytes, but never has appearance of pus. *Suppuration never occurs.*

Directly acute symptoms subside, joint usually appears normal.

TEMPERATURE.—Rise rapid, 101° to 103° or 104° : rarely higher. Irregular. Falls gradually. First recorded temperature usually the highest, owing to subsequent administration of salicylates. Pyrexia after five days' treatment with salicylates suggests endocarditis or pericarditis, or error of diagnosis.

HEART.—Systolic murmur frequent at apex. May be: (a) *Myocardial*, disappearing on treatment; (b) *Endocardial*, subsequently progressing and becoming permanent.

PULSE.—At onset 100 to 120. Soft. Tracings often show slight irregularity. Falls with temperature. With salicylates may become very slow, 40 to 50, but this is of no importance.

URINE.—Febrile type. Trace of albumin occasionally.

BLOOD.—Polynuclear leucocytosis. Secondary anæmia develops rapidly.

Progress.—In absence of complications and without drugs fever and acute symptoms subside in about ten days. With salicylates rarely exceed four days.

Subacute Rheumatic Fever.—No definite dividing line from acute. All symptoms less marked. Duration may be long. Cardiac lesions common.

Relapses.—Very frequent: in 15 per cent of first or second attacks.

Complications.—Those of importance are: (1) Cardiac; (2) Hyperpyrexia; (3) Pulmonary; (4) Nervous; (5) Cutaneous; (6) Rheumatic nodules.

CARDIAC LESIONS.—Though described here as a complication, cardiac changes are truly a part of the disease as much as arthritis.

ENDOCARDITIS.—Most serious feature of rheumatism. For symptoms, etc., see **ENDOCARDITIS**. Special features:—

Frequency about 50 per cent of cases. Increases with number of attacks, diminishes with age. Children rarely escape.

Valves commonly affected, in order of frequency: (1) Mitral alone; (2) Mitral and aortic; (3) Aortic alone—rare.

Mitral stenosis only develops slowly, and hence is not recognizable during acute stages of a first attack.

Pathological changes are of simple endocarditis: verrucose and infective form rare during attack of rheumatism.

Subsequent progress.—Signs and symptoms of endocarditis slight in first attack, but pathological changes tend to advance after attack of rheumatism has passed.

Mortality low during the acute attack.

Rheumatic Fever—Complications, *continued*.

PERICARDITIS.—Especially in children. Special features: (1) Commonest in hospital class, sexes equal; (2) Slightly more frequent in first attacks, but mortality in first attack is 40 per cent and in second 10 per cent; (3) May occur at any time during attack, with or without endocarditis; (4) Effusion may occur (20 per cent of cases), *but is never purulent*; (5) Arthritis usually severe.

In fatal cases, endocarditis also nearly always present.

MYOCARDITIS.—Probably frequent, leading to dilatation. No definite signs.

HYPERPYREXIA.—Extremely rare. Never in children under 12. Usually in second week of first attack. Temperature may rise to 108°. *Delirium* or *pericarditis* commonly present (*see* NERVOUS COMPLICATIONS *below*). Pulse feeble, stupor and death.

PULMONARY COMPLICATIONS.—Rare. Pleurisy may occur with pericarditis, usually dry, but may be effusion. No true pneumonia, but occasionally collapse and congestion.

NERVOUS COMPLICATIONS.—Apart from chorea, are extremely rare.

CHOREA.—Associated with rheumatism not uncommonly, but mainly in children.

DELIRIUM ('Cerebral rheumatism').—Occurs with hyperpyrexia or pericarditis (or both together). Probably never independently. Delirium may be active or quiet. Passes into coma. Mortality very high. Rare.

CUTANEOUS COMPLICATIONS.—In acute stage skin is moist. Drenching sour sweats are characteristic before introduction of salicylates.

ERYTHEMATA.—Frequent in children.

PURPURA.—Rare, but may occur, especially in children.

ERYTHEMA NODOSUM.—From frequency of various erythemata in rheumatic fever was formerly accepted as rheumatic, but now doubted (*see* p. 294).

RHEUMATIC NODULES.—Evidence of serious attack. Occur on fibrous tissue and periosteum of bones lying close under the skin, e.g., olecranon, tendons and fasciæ especially about elbows and wrists, also on scapulæ and vertebræ. Number usually three or four, rarely twenty to thirty, occasionally very numerous. Best recognized by drawing skin tight and palpating gently. Almost confined to children. Pericarditis has been observed subsequently in many cases.

Diagnosis.—Usually simple. Temperature always subsides within five days of efficient salicylate treatment, unless endocarditis or pericarditis present. Diagnosis in adults from:—

ACUTE ARTHRITIS DEFORMANS (osteo-arthritis).—Tends to attack smaller joints. Chronic articular changes.

SECONDARY ARTHRITIS.—Septic arthritis in pyæmia and septicæmia. Gonorrhœal arthritis (q.v.). Rare: scarlet fever, dysentery.

GOUT.—Age of patient ; etiology ; previous attacks ; small joints usually affected, especially great toe and thumb.

Mortality.—In acute attacks, very low, not exceeding 2 to 3 per cent, which is mainly due to cardiac complications. Great indirect mortality from cardiac lesions. Hyperpyrexia has high mortality, but is very rare.

Treatment.—Indication is to protect heart specially.

REST IN BED.—At least four weeks after temperature normal ; between blankets in early stages. If heart is involved, at least three months.

DIET.—Milk and milk foods during pyrexia. Fluids and lemonade in large amounts.

LOCAL TREATMENT.—Wrap limbs in warm cotton-wool. Cradle to support weight of bed-clothes. If much pain, paint with methyl salicylate, or use sodium bicarbonate fomentations.

SALICYLATES.—Sodium salicylate recommended for routine use : to be prescribed with sodium bicarbonate.

R	Sodii Salicyl.	gr. xx	|	Syr. Aurantii	℥xx
	Sodii Bicarb.	gr. xl	|	Aq. Chloroformi	ad ʒj

Every 2 hours for 6 doses. Every 4 hours until temperature falls.
Three times daily for further three weeks.

Aspirin or salicin may be used if temperature does not fall, especially in children.

Action of Salicylates. Usually rapid. Ease the articular pains, and cause fall of temperature. It is doubtful whether they lower the incidence of endocarditis.

PAIN SEVERE.—Nepenthe, or Dover's powder.

HYPERPYREXIA.—Hydrotherapy, as in typhoid fever.

ENDOCARDITIS.—*See* ENDOCARDITIS.

RHEUMATIC NODULES.—Rest in bed until all nodules have completely disappeared.

TONSILS.—Remove if affected ; preferably after attack.

Rheumatic Fever in Children.—Differs from clinical condition in adults by more insidious character. Does not occur under 2 years of age.

ARTICULAR LESIONS.—Often slight and overlooked ; and endocarditis often progresses to mitral stenosis and incompetence without any illness being observed. Recurrent tonsillitis or sore throat may be the only manifestation, or possibly endocarditis may occur without other symptoms.

COMPLICATIONS are more common in childhood : chorea, pericarditis, rapid anæmia, and also subcutaneous nodules.

DIAGNOSIS.—From :—

ACUTE OSTEOMYELITIS.—Constitutional symptoms very severe. Pain is not in joint.

ACUTE POLIOMYELITIS.—May be associated with hyperæsthesia.

INFANTILE SCURVY.—Age under 2 years.

Rheumatic Fever in Children—Diagnosis, continued.

CONGENITAL SYPHILIS.—Occurs as (1) *Syphilitic epiphysitis*: age under 2 years, affects epiphyses and not joints. (2) *Symmetrical synovitis*: painless, at age of puberty.

STILL'S DISEASE.—Rare. Chronic. Spleen and glands often enlarged. Heart unaffected.

CHAPTER XLVIII.

ERYTHEMA NODOSUM.

Characterized by tender erythematous swellings usually confined to extensor aspects of lower limbs.

Etiology.—Mainly in children and young adults. Females commoner.

Pathogenesis.—Uncertain. May be several groups. Formerly considered rheumatic, but note: (1) Cardiac lesions rare; (2) Salicylates no effect; (3) Joint pains not greater than in urticaria. Some cases may be a mild specific or streptococcal infection. Epidemics recorded. Syphilis not a factor. Tuberculosis alleged.

Symptoms.—

1. **LOCAL ERUPTION.**—(i) Round or oval swellings. (ii) Usually on extensor aspects of lower limbs, rare above knees: occasionally on arms. (iii) Bilateral. (iv) Size: up to two inches in diameter. (v) Number very variable. (vi) Colour: red deepening to purple. (vii) Very tender. Swelling involves subcutaneous tissues: may be oedema around. *Duration*: 10 to 20 days.
2. **CONSTITUTIONAL.**—Slight pyrexia and malaise. May be sore throat and joint pains.

Diagnosis.—Simple. (Examine the heart.) Second attacks rare.

Treatment.—Symptomatic. Rest in bed.

CHAPTER XLIX.

ACUTE CORYZA.

(*Acute Rhinitis. Common 'Cold'.*)

Acute inflammation of mucous membrane of upper air-passages.

Etiology.—

DISTRIBUTION.—Widespread in temperate and cold regions.

SEASONS.—Especially at changes of temperature, as in early winter and early spring. Chilling of body, e.g., draught in hot room, or after perspiring, are common factors.

AGE.—No age immune: children very susceptible.

CAUSAL ORGANISM.—Unknown: probably filter-passing virus. Various cocci may be associated. Early watery discharge is often sterile.

INFECTIVITY.—Varies greatly with : (1) Individual : marked idiosyncrasies. (2) Outbreak : schools and households often affected.

Symptoms.—

INITIAL STAGE.—Chill, sneezing, head feels heavy, skin dry.

NASAL MUCOUS MEMBRANE.—*First Stage* : congested ; unable to breathe through nose ; duration one to three days. *Second Stage* : watery discharge ; duration two to seven days. *Third Stage* : mucopurulent discharge ; gradually subsides. Chronic rhinitis may persist.

Inflammation often spreads to : (a) *Tonsils* : Sore throat, common initial symptom. (b) *Pharynx* : Swallowing painful. (c) *Larynx* : Voice husky. (d) *Eustachian tubes* : Deafness. (e) *Conjunctivæ and tear ducts* : Eyes 'run'. (f) *Œsophagus*.

Temperature and pulse moderately raised.

Smell, taste, and appetite affected. Constipation common.

Extension to trachea or bronchi produces 'cold on the chest' (acute bronchitis).

Treatment.—No treatment is reliable to abort attack, but immediate confinement to bed and free diaphoresis will often do so. Warmth is essential : hot-drinks, hot water-bottles, acetylsalicylic acid, or quinine (tinct. quin. ammon. ʒj, t.d.s., for adult). Essential oils, e.g., cinnamon, are excreted by nasal mucous membrane and are helpful. *Nasal douches* reduce watery or mucopurulent discharge ; e.g., Dobell's solution or alkaline nasal douche from atomizer :—

R	Sod. Bicarb.	gr. xx	|	Glycerini	ad ʒj
	Boracis	gr. xx		Aq.		ʒiv

Mix with an equal amount of warm water.

Bed for two days in earlier stages if severe. Brisk purgative. Light diet.

In convalescence : iron and strychnine tonic, cod-liver oil.

VACCINE TREATMENT.—For recurrent 'colds'. Of prophylactic value only, but effective in some cases. Prepared from culture from patient's mucous membrane. Stock vaccines are also in use, containing streptococcus, pneumococcus, and influenza bacillus.

PROPHYLAXIS.—For recurrent colds, examine nose and throat for enlarged tonsils, etc. Protect against chills, in moderation.

Diagnosis.—Measles commences with typical coryza.

CHAPTER L.

GLANDULAR FEVER.

(*Infective Mononucleosis.*)

An acute infectious disease characterized by enlargement of lymphatic glands, changes in the blood-cells, especially mononucleosis, the presence of heterophile antibodies in the serum, and a uniformly favourable course.

Glandular Fever, *continued*.

Etiology.—Commonest in children, but no age immune. Occurs sporadically and in epidemics. Wide geographical distribution.

Morbid Anatomy.—*Lymphatic Glands*: In acute stages, hyperplasia of reticulo-endothelial and lymphoid tissues; later, fibrous tissue increased.

Mode of Infection.—Direct contact. Degree of infectivity not high, but with mass infection may cause extensive epidemics in schools and institutions. *Virus* unknown; probably a filter-passer; may be protozoon of genus *Toxoplasma* (Bland).

Incubation Period.—Normal limits 5 to 12 days.

Duration of Infectivity.—Unknown. Isolate for one week after mass of glands has subsided and temperature normal.

Clinical Types.—(1) *Glandular or Pfeiffer's Type*: characterized by degree of glandular enlargement: in adults constitutes type known as 'infectious mononucleosis'. (2) *Anginose Type* (monocytic angina): characterized by formation of diphtheroid membrane on tonsils. (3) *Febrile Type*: characterized by prolonged febrile course. *Aglandular* cases also occur. Intermediate forms not uncommon.

I. GLANDULAR OR PFEIFFER'S TYPE.—Most common between ages of 6 and 15 years. Also in young adults, but glandular enlargement less and symptoms mild, constituting 'infectious mononucleosis'.

ONSET.—May be prodromal period of few days with mild constitutional symptoms. Complaint of sore throat common.

ENLARGEMENT OF LYMPHATIC GLANDS.—On second or third day or as initial symptom. Increase often rapid; may be unilateral at onset. *Cervical glands* most affected, often large gland deep to sternomastoid in upper third; may form large mass; occipital, pre-auricular, and other glands occasionally. Axillary glands usually enlarge later, and inguinal less constantly; never parotid. Glands discrete, slight discomfort, pain rare. No œdema. Torticollis occasionally. Mediastinal and mesenteric glands may enlarge, causing cough, pulmonary, and abdominal symptoms.

FAUCES.—Slight reddening and discomfort: tonsils often prominent without exudation.

GENERAL SYMPTOMS.—Constitutional symptoms slight. Constipation usual. Conjunctivitis occasionally. Epistaxis may be severe. Torticollis occasionally. *Eruptions* not common. *Spleen* often becomes palpable; also liver.

Blood.—(1) *Leucocytosis*: often 8000 to 15,000 or up to 40,000. (2) *Mononucleosis*: 60 to 80 or rarely 90 per cent. Initial polynucleosis rarely observed. Usually returns to normal in few weeks.

Course.—Main mass of glands usually subsides rapidly in few days. May be recurrences. Pyrexia rarely exceeds two weeks.

2. **ANGINOSE TYPE.**—Rarer than other types. Apparently non-infectious and may be a complication. Commonest between 15 and 25 years.

ONSET.—Prodromal period usually one to three weeks; may be mild initial attack of glandular type; gradual increase of constitutional symptoms, sore throat, and discomfort in neck.

FAUCES.—Membrane forms rapidly, indistinguishable from diphtheria; never involves larynx; may be peritonsillar œdema.

LYMPHATIC GLANDS.—Cervical glands enlarged, may be obscured by œdema, usually painful; often suggests suppuration, but this is very rare. Axillary, other glands, and spleen may be palpable.

BLOOD.—Leucocytosis and mononucleosis always present when membrane has formed.

COURSE.—Faucial discomfort great, mental anxiety, temperature 104° , but general condition remains good. Membrane may persist several days; improvement follows separation; pyrexia may last one or two weeks or more. *Convalescence* may be slow.

3. **FEBRILE TYPE.**—Represents the full development of glandular fever. Usually in adults. The following description is typical, but variations are common. There are three stages:—

STAGE OF INVASION.—Onset usually sudden: headache, malaise, rigors. No sore throat. Temperature 102° to 103° , irregular, tends to fall. Pulse not unduly rapid; may be slow. Duration: 3 to 7 or 10 days.

Blood.—May be polynucleosis—total 12,000 to 15,000 with 80 per cent polynucleosis; or neutropenia—total 3000 with relative lymphocytosis; or within normal limits.

STAGE OF ERUPTION.—

Eruption.—Onset usually 4th or 5th day; may be up to 10th day. Maculo-papular is commonest form. Fade in a few days, but may be crops. Eruption may be absent.

Temperature.—At onset of eruption 102° to 103° . As spots fade, temperature falls.

Sweating often profuse: may be rigors. Epistaxis not uncommon.

Spleen not palpable (may be palpable late in stage).

Blood.—At onset, leucocytes 10,000 to 15,000. Differential count usually normal. Number tends to fall later in stage; may reach 3000. Mononucleosis may develop towards end of stage.

Duration.—Usually 10 to 14 days; may be longer.

STAGE OF GLANDULAR ENLARGEMENT.—

Glandular Enlargement.—Onset usually in 3rd week. Enlargement not extreme. Cervical glands most prominent, but all superficial glands tend to enlarge,

rubella. Eruption may also resemble that of measles, scarlet fever, typhus, chicken-pox, erythema, and urticaria.

Aglandular Forms.—May be no enlargement of superficial glands. Course may resemble severe febrile type with prolonged pyrexia and marked constitutional symptoms: mononucleosis may develop late: glands may enlarge during recrudescence.

Complications.—

1. *Hæmaturia* may occur: transient 'acute hæmorrhagic nephritis'. No chronic nephritis. Rarely rectal hæmorrhage. Purpura very rare.
 2. *Suppuration of glands* very rare: may occur 2 to 3 weeks after onset if glands still large. Polynuclear leucocytosis develops.
 3. Glands may remain palpable for many months.
 4. Convalescence often very slow: anæmia may develop, and some mental and physical exhaustion remains for many months. In rare cases, enlargement of mediastinal glands has produced pulmonary complications.
- Complete recovery finally in all forms.

Diagnosis.—By glandular enlargement, blood changes, and presence of heterophile agglutinins, and clinical features. Difficulties may arise from:—

1. *Febrile Type.*—Absence of suggestive features: may be mistaken for enteric.
2. *Anginose Type.*—Resemblance to diphtheritic membrane.
3. *Eruptions.*—Resemblance to various specific fevers.
4. *Glandular Enlargement.*—Mumps, tonsillitis, Hodgkin's disease, tuberculosis.
5. *Mononucleosis.*—Leukæmia. *Note:* numerous types of monocytes, absence of anæmia, general condition good. Initial polynucleosis may cause errors of diagnosis.

ACUTE BENIGN LYMPHOCYTIC MENINGITIS.—In glandular fever meningism may rarely occur, and lymphocytosis has been recorded in cerebrospinal fluid. Relationship of the two diseases not yet studied.

Treatment.—

ACUTE STAGES.—Symptomatic. In adult type, injections of convalescent serum, and arsenical preparations may be tried.

CONVALESCENCE.—Needs care, rest, and tonics.

CHAPTER LI.

TRENCH FEVER.

An infectious disease due to an unknown virus transmitted by the excreta of lice, and characterized by an initial febrile period, a tendency to relapses and periodic pyrexia, and frequently by hyperæsthesia of the shins. Never fatal.

Trench Fever, *continued*.

History.—Occurred during the Great war to an enormous extent among troops on active service. Few cases among civilians, and disease has now disappeared.

Mode of Transmission.—Virus unknown: possibly a *Rickettsia* (*See* TYPHUS).

1. Virus is present in blood of patients: can be transmitted by inoculation of blood or of plasma, hence is not intra-corporal. Is present also in urine and sometimes in saliva, but not in faeces. Virus can pass a Chamberland L filter. Killed in an hour at 70° C. but not at 60° C.
2. Transmission by lice fed on trench-fever patients: (a) Bites do not convey infection; (b) Excreta of lice inoculated by scarification convey the infection; (c) Lice crushed and rubbed into scarification convey the infection.
3. Lice after feeding are not infectious for five days, i.e., a cycle occurs in body.
4. Lice are infective for at least twenty-three days.
5. Virus is not transmitted to offspring.
6. Virus is not normally present in lice.
7. Virus has been transmitted from a patient eleven weeks after attack.

Types of Fever.—Several types of trench fever were described originally, e.g., a short form, a long form, and a relapsing pyrexia. It is now probable that the relapsing pyrexia is invariably preceded by an initial febrile attack. The long and short forms practically vary only in duration, and may be grouped as the initial fever.

Symptoms of Initial Fever.—

INCUBATION PERIOD.—About two to three weeks under ordinary conditions. By scarification: about eight days. By simple transference of lice to healthy persons: fourteen to thirty-eight days.

ONSET.—Sudden. Often previous malaise is present for two or three days.

GENERAL SYMPTOMS: (1) *Headache* severe: frontal and at back of eyes. (2) *Giddiness*. (3) *Pains in back and legs*. (4) *Sweats*, often profuse. (5) *Face* flushed. (6) *Conjunctivitis* common. (7) General febrile symptoms: anorexia, constipation, shivering, but no definite rigors; vomiting occasionally. (8) Herpes labialis occurs occasionally. (9) *Spleen*: enlarged in about one-third of the cases. Usually tender. (10) *Tenderness and pains in shins*: most characteristic symptom; often very acute. Usually not present in first few days. Especially lower half of shins. Pain, also severe, may occur in thighs and knees; sometimes in calves, but this often entirely absent. (11) *Rash*: pale pink irregular erythematous or roseolar spots, do not project, disappear readily on pressure. Do not occur in more than one-third of the cases, and usually not until relapses or the periodic rises. Formerly mistaken for enteric spots. (12) *Blood*: may be moderate leucocytosis.

Pyrexia.—**A. INITIAL FEVER.—**

SHORT FORM.—Duration usually three to six days; often fluctuates; then falls to normal. *Relapses* very frequent. *Temperature* may be irregular, subsequently, sometimes for long periods, even in absence of definite relapses.

LONG FORM.—Duration six to twenty days.

B. RELAPSING PYREXIA.—

Periodic rises occur, usually at five-day intervals: feels well in intervals.

Febrile period one to two days: temperature 102° to 104° ; pulse rapid. Symptoms as in initial fever.

Occurs in small proportion of cases. May follow directly on initial fever or after interval of weeks. Initial fever may be overlooked.

Attacks tend to diminish; duration of pyrexia may be very short, a few hours only, may be unnoticed (or possibly absent), while malaise, increased pulse, and other symptoms occur.

Identical febrile attacks may occur many months after infection.

Sequelæ.—(1) Slight febrile attacks; (2) Myalgia; (3) Tachycardia; (4) Debility may result from the constant shin pains and pyrexia. Endocarditis never results.

Progress.—Never fatal. Shin pains often persist after other symptoms have subsided. Complete recovery finally.

Treatment.—Confine to bed at least three weeks in initial attack: main object is to save the heart. No drug has any effect on temperature, or on the shin pains if severe.

CHAPTER LII.

PHLEBOTOMUS FEVER.

(*Sandfly Fever. Papataci Fever. Three-day Fever.*)

An acute specific fever of short duration caused by a filterable virus conveyed by the bite of the sandfly (*Phlebotomus papatasi*).

Distribution.—East Mediterranean, India, Persia.

Mode of Infection.—DOERR, 1908, proved that infection followed the bites of sandflies, and reproduced the disease by injecting his infected blood into a healthy subject. Sandfly infectious six days after biting. Patient's blood infectious for first 24 hours.

Symptoms.—*Incubation*: one to six days. *Invasion*: Rigor, severe headache, conjunctivitis, general pains. Temperature 103° to 104° , rising in twenty-four to thirty-six hours. Then defervescence; may be accompanied by sweating, vomiting, or diarrhœa. *Duration*: three days. No eruption. No desquamation. No

Phlebotomus Fever—Symptoms, *continued*.

recrudescence. No complications. No sequelæ, except some weakness. Never fatal.

Prophylaxis.—General sanitary measures diminish prevalence of sandflies. Small size of fly enables it to pass through mosquito netting.

CHAPTER LIII.

OROYA FEVER.

An acute specific fever characterized by rod-shaped bodies in the red cells and by rapidly developing anæmia.

Distribution.—Confined to certain narrow hot valleys on western slopes of the Andes.

Etiology.—The rod-shaped 'Barton's bodies' are considered to be protozoa causing the disease, *Bartonella bacilliformis*. Mode of transmission uncertain. All ages and sexes susceptible.

Morbid Anatomy.—Spleen enlarged: Barton's bodies in endothelial cells; also in lymphatic glands. Bone-marrow proliferated.

Symptoms.—

INCUBATION PERIOD.—Three weeks.

ONSET insidious, but progress rapid in severe cases.

TEMPERATURE rises: irregular. Falls in fourth week.

PAINS, diffuse and severe. Bones often tender.

ANÆMIA develops very rapidly: red cells may fall to 500,000 per c.mm. in few days (blood resembling pernicious anæmia). Polynuclear leucocytosis (20,000). Barton's bodies numerous in severe cases during pyrexia.

Lymphatic glands enlarge. Liver and spleen palpable, and tender. No eruption.

Prognosis.—Bad in severe cases: death in coma in two to three weeks. Mortality in epidemics may be 30 to 40 per cent.

Diagnosis.—By examination of blood.

Treatment.—No specific treatment.

VERRUGA PERUANA.

Attributed to same organism as that responsible for oroya fever.

Incubation Period.—Sixty days or over: or 30 to 40 days after a previous attack of oroya fever.

Onset.—Pyrexia. Rheumatic pains.

Eruption.—Miliary papules or larger nodular excrescences; are granulomata. On skin and mucous membranes. Hæmorrhages often extensive—e.g., from alimentary tract. Eruption desiccates.

Mortality.—Low.

Treatment.—None effective.

CHAPTER LIV.

PSITTACOSIS.

An acute infective disease due to a filterable virus. Characterized by fever, constitutional disturbances, and pulmonary complications. Human infection is primarily conveyed from parrots.

Animal Infections.—Parrots and budgerigars most susceptible. Also laboratory animals and canaries. Affected birds exhibit general malaise, sneezing, and signs of a 'cold', and often intractable diarrhoea and vomiting.

Virus.—Easily filterable. Maintains virulence for considerable periods. *B. psittacosis* is identical with *B. aertrycke*; occasionally affects parrots, but is not cause of disease psittacosis. Infection occurs from bird to bird, from bird to man, and from man to man. Bird after recovery from illness may remain carrier for many months (at least 8). Laboratory infections occur readily.

Morbid Anatomy.—Areas, scattered or confluent, of hæmorrhagic pneumonia. General septicæmia.

Symptomatology in Human Beings.—

INCUBATION PERIOD.—Usually 7 to 14 days.

ONSET.—Usually rapid. Temperature high from onset. Resembles atypical enteric: malaise, collapse, headache, anorexia, nausea, may be epistaxis. Also vomiting, sweating, shivering, photophobia.

PULMONARY SYMPTOMS.—Cough from the onset, or later in the first week: often spasmodic. Respiration not increased in frequency. In second week, consolidation of lungs: physical signs very variable. No pleural effusion.

INTESTINAL SYMPTOMS.—Abdominal distension may be marked. Constipation obstinate. Spleen not palpable. May be slight diarrhoea, but rarely prominent.

Eruptions occasionally present: no constant character: may suggest enteric. *Leucocytosis* is absent. *Diphtheroid stomatitis* develops from mouth-to-mouth feeding of sick parrots.

Progress and Prognosis.—In favourable cases, fever lasts 15 to 20 days: lungs clear gradually. Long convalescence. Mild forms also occur, especially in children and young adults. In fatal cases lungs show thrombosis and hæmorrhagic pneumonia. Mortality about 20 per cent, due to pulmonary complications.

Diagnosis.—Usually by record of association with sick parrots. Especially from influenza and enteric. Note that blood serum occasionally agglutinates enteric and salmonella organisms.

Treatment.—No special treatment.

Section II.—DISEASES DUE TO PHYSICAL AGENTS.

CHAPTER LV.

EFFECTS OF HEAT. CAISSON DISEASE.
EFFECTS OF ELECTRICITY.

EFFECTS OF HEAT.

Certain conditions result from exposure to high temperatures, and may be divided into two groups: (1) Heat exhaustion; (2) Sunstroke. (See also FIREMAN'S CRAMP.)

Factors.—(1) High temperature, especially on successive days; (2) Humidity; (3) Stagnation of air. These factors diminish heat loss and evaporation from skin. Leonard Hill's katathermometer measures conditions.

HEAT EXHAUSTION.

Results from exposure to high temperatures, either from sun or artificial. Occurs in: (1) Climatic conditions in (a) Tropics, (b) Temperate zones during heat waves; (2) Stokeholds and engine-rooms.

Predisposing Causes.—(1) Alcohol; (2) Ill-health, and gastrointestinal disease; (3) Heavy clothing, preventing evaporation; (4) Fat persons. Dark races more resistant than Europeans.

Symptoms.—Giddiness, nausea, followed by fainting. With syncope, skin cold and clammy, pupils dilated, *temperature usually sub-normal*. Recovery rapid, with headache and some weakness. Rarely, coma and death.

Onset of symptoms may occur during exposure to heat, or after interval of some hours, or following morning.

Treatment.—See p. 305.

SUNSTROKE.

(Insolation.)

Results from exposure to the sun. *Distribution*: (1) Tropics; (2) Temperate zones during heat waves. Common in New York, and Atlantic coast towns.

Predisposing Causes.—As for heat exhaustion, especially alcohol.

Morbid Anatomy.—Early onset of rigor mortis. *Blood* remains very fluid. General congestion of organs. Right heart dilated. Parenchymatous degeneration of cells of central nervous system, liver, and kidneys. Decomposition rapid.

Symptoms.—Two types:—

1. Onset with headache, giddiness, nausea, thirst, and great

Sunstroke—Symptoms, continued.

exhaustion. May be epigastric pain and vomiting, and disturbance of vision. Unconsciousness follows, either transient or passing into deep coma.

2. Onset of unconsciousness occurs with great rapidity.

Condition during Unconsciousness.—

TEMPERATURE.— 107° to 110° or even 112° . Face flushed, skin hot.

PULSE.—Rapid and full: later slow. RESPIRATION deep.

PUPILS.—Dilated or, later, contracted.

MUSCLES.—Flaccid: less often rigid. Fibrillary twitching common. Rarely, convulsions.

Course.—

1. Recovery complete. Headache usually severe.
2. Coma deepens. Failure of heart and respiration. Death in twenty-four to thirty-six hours.
3. When onset sudden, may be death within one hour, or almost instantaneously ('asphyxial' type).

Sequelæ.—

1. Inability to bear high temperatures.
2. Defective memory and mental powers: probably from chronic meningitis.

Diagnosis.—From malignant malaria by (a) blood examination, (b) rapid unconsciousness. From cerebral hæmorrhage: no paralysis.

Prognosis.—Unfavourable in alcoholics, and in elderly, fat, and debilitated subjects.

MORTALITY.—In severe forms 30 to 40 per cent: depends greatly on supply of ice.

Treatment.—

HEAT EXHAUSTION AND MILD FORMS.—Rest. Loosen and open clothing, especially round neck. Cold water to head. If temperature very low, hot bottles. Ammonia and stimulants. For subsequent headaches, phenacetin or aspirin (gr. x).

SUNSTROKE.—*Indication:* Reduce temperature as rapidly as possible. *Apply ice:* (a) Ice-bath, preferable. (b) Ice placed on or rubbed over skin and round head, with *thermometer in rectum*, ceasing when temperature falls to 104° . (c) Ice-water enemata. *Artificial respiration*, if necessary. For convulsions, venesection. Antipyretics to be avoided, owing to cardiac depression: may be given in absence of ice or cold water.

If malaria suspected, intravenous injection of quinine.

Prophylaxis.—

ALCOHOL.—To be avoided. Also excess of exercise and food.

LIGHT CLOTHING.—Non-active colours, red or yellow, preferable.

HEAD, BACK OF NECK AND SPINE.—To be protected.

Correct constipation and errors of refraction. Tinted glasses to be worn: smoked, brown, or yellow: not blue.

CAISSON DISEASE.

(Compressed-air Disease. Divers' Paralysis.)

A disease of caisson workers and divers, and workers under high atmospheric pressures, characterized by pains and paralysis occurring after return to normal atmospheric pressure, and due to formation of bubbles of nitrogen from supersaturated tissues.

During compression, viz., under the high atmospheric pressure of the occupation, the tissues absorb much nitrogen from the blood. The amount absorbed varies with : (1) The *pressure*. Each 33 feet of water adds one atmospheric pressure (14.7 lb. per sq. inch). (2) The *duration of exposure*. In about $1\frac{1}{2}$ hours the tissues are practically fully saturated for the particular pressure present. (3) *Muscular work*. Increases rapidity of absorption.

During subsequent decompression, viz., return to normal pressure, tissues pass into condition of supersaturation, and must part with nitrogen in order to establish equilibrium with the surrounding air. If decompression be sufficiently slow, the blood can remove the excess and discharge it through the lungs. If decompression be too rapid, bubbles of nitrogen gather in the tissues and produce symptoms either by obstructing circulation (air-emboli), or by destroying tissue, e.g., in nervous system. Tissues can hold 35 times as much nitrogen as the blood; amount set free may be enormous, producing subcutaneous emphysema and abdominal distension.

Factors in this phenomenon are :—

1. The higher the pressure, the longer the working shift, and the shorter the period of decompression, the greater is the risk.
2. The brain and cord are practically in closed cavities : further, the spinal circulation is slow. Hence the affection of the nervous system.
3. Fatty tissue absorbs much nitrogen.

Divers go to greater depths than caisson workers, but for shorter periods and lighter work, and hence are less affected. Record is 210 feet. *Tunnel workers* are also under compressed air.

Morbid Anatomy.—Laceration in spinal cord. Congestion of nervous system and internal organs. May be much gas in heart-blood : analysis has shown 82 per cent nitrogen (symptoms partly due to air-emboli). In chronic cases, may be typical chronic myelitis.

Symptoms.—

ONSET.—Usually half to one hour after decompression.

MILD FORMS.—Headache, giddiness, faintness : transient.

SEVERE FORMS.—(1) *Agonizing pains*, chiefly legs and abdomen ("the bends"). (2) *Paralysis* : rapid onset, usually legs and abdomen : both sensory and motor. All degrees. Occasionally : headache, giddiness, vomiting.

EXTREME FORMS.—Unconsciousness of apoplectic character. Rapid death.

Progress.—

RECOVERY.—Usual. Depends on facilities for recompression.

PARALYSIS.—(a) May recover in few days even when complete, or gradually; (b) Permanent, similar to transverse myelitis.

Secondary hæmorrhage may occur in affected tissues.

RAPID DEATH.—In cases severe from onset.

Prognosis also varies with: (a) Age (50 years should be maximum age in such occupations); (b) Condition of heart; (c) Degree of adiposity.

Prophylaxis.—Gradual decompression, affording time for escape of nitrogen. Two principal methods:—

a. Leonard Hill.—Decompress at pressure of 20 lb. for a period which allows 20 minutes for each atmosphere present during occupation.

b. Haldane and Boycott's 'Stage Method'.—Decompression in several stages, at various pressures, for periods *increasing* as pressure approaches normal.

Both methods are effective, cases of disease only rarely occurring. Hill's method is simplest. To prevent *cardiac exhaustion*, no shift at high pressures should exceed two hours. During decompression, escape of nitrogen is aided by muscular movements and by a high percentage of oxygen.

Treatment.—If symptoms commence, subject must be recompressed in a medical air-lock, and very slowly decompressed.

EFFECTS OF CURRENTS OF ELECTRICITY.

Strength of Current.—Current of 500 volts is usually fatal. Lower currents, even 120 volts, may be fatal. *Alternating* currents are *more dangerous* than direct currents.

Grip cannot be relaxed when grasping a current of 50 volts with wet, or 100 volts with dry, hands. Current of 65 volts has been fatal, and one of 6000 volts non-fatal (Oliver). A current of 1500 volts is used in America for electrocution.

EFFECTS.—Vary greatly with: (1) *Moisture of skin*, and degree of insulation, e.g., wet boots; (2) Duration and completeness of contact; (3) General health or debility.

ACTION.—(1) High currents (over 1200 volts) inhibit nervous centres; (2) Lower currents are fatal by causing fibrillation of the heart; (3) Spasm of muscles; (4) Burns.

Morbid Anatomy.—Changes slight. Capillary hæmorrhages and congestion of nervous system occasionally. Blood usually fluid; reduced hæmoglobin present. Burns may be present.

Symptoms.—

NON-FATAL.

MUSCLES.—With passage of current, muscles contract in tetanic spasm: hence a grip cannot be relaxed until circuit is broken. Results in (1) great pain, (2) terror.

SYNCOPE.—Common: usually short duration.

Effects of Electricity—Symptoms, *continued*.

SEQUELÆ may be :—

1. Neuroses : common, from terror or shock.
2. Hemiplegia and other organic paralyses : very rare, but apparently authentic.
3. Visual disturbances.

FATAL.—Severe spasm of all muscles, may throw body some distance from source of current : often a cry. (1) Death instantaneous, high currents inhibiting nerve centres ; (2) Unconsciousness, heart ceases, death in three to four minutes.

BURNS.—May occur either in fatal or non-fatal cases. Vary greatly with moisture of skin and duration of contact.

CHARACTERISTICS :—

Skin blackened and dry. Never moist. Never suppurates. *Painless*, but surrounding tissues often tender.

Loss of substance usually slight.

Heal very slowly. Burn may affect all tissues to bone.

Gangrene may occur.

Treatment.—

If the body is in contact with the current.—Preferably switch off current. If impossible, kick body away, or use hands covered with rubber gloves or with dry cloth. (*Faute de mieux*, a man may remove his coat, and, holding the inner side before him, pass his hands half way down the sleeves.) Never use bare hands.

If patient is unconscious.—Artificial respiration, *to be persisted with for at least two hours.* Violent shaking, etc., as sometimes used, is dangerous but may be effective. When spontaneous respiration is established, continue with : (1) Cardiac stimulants ; (2) Lumbar puncture ; (3) Sedatives if restless, e.g., intramuscular luminal or morphia injection. (Prolonged coma is due to cerebral œdema : hyperpyrexia usual at onset.)

Section III.—THE INTOXICATIONS.

CHAPTER LVI.

ALCOHOLISM.

The effects of excess of alcohol are here considered in groups
 (1) *Acute alcoholism.* (2) *Chronic alcoholism.* (3) *Delirium tremens.*
 (4) *Various other manifestations:* (i) Korsakow's syndrome; (ii) 'Wet brain'; (iii) Acute hallucinosis; (iv) Alcoholic automatism; (v) Dipso-
 mania; (vi) Relation to other diseases—insanity, tuberculosis,
 pneumonia. (5) *Special forms of alcohol poisoning.*

Hereditary Influence.—Alcoholism commonest in families with unstable nervous system.

1. ACUTE ALCOHOLISM.

Characterized usually by: (1) Flushed appearance and congestion; (2) Inco-ordination; (3) Lack of mental control; (4) Speech thick. *Alcoholic coma* may follow, in which: (i) Person can be roused temporarily; (ii) Pupils are dilated (serious if contracted); (iii) Pulse is full; (iv) Respirations deep; (v) Temperature is subnormal; (vi) Limbs flaccid, reflexes diminished, plantar reflex flexor. Occasionally rapid onset following large amounts of undiluted spirits. Condition of collapse may be fatal.

Definition of Drunkenness.—A person can be declared to be drunk if as the result of alcohol he is unable to do with safety that which he is attempting.

DIAGNOSIS.—From other forms of coma (*see* COMA, p. 315).

Treatment.—A debauch involves a long sleep, a purgative, and a day of nausea and disgust.

ALCOHOLIC COMA.—Wash out stomach with warm sodium bicarbonate solution and leave in hot coffee. Hot bottles, and stimulants if collapsed.

ACUTE ALCOHOLIC MANIA.—Inject apomorphine gr. $\frac{1}{10}$ to $\frac{1}{8}$.

Blood and Urine.—Blood may contain 0.3 to 0.6 gm. per cent alcohol, and urine similar amount.

2. CHRONIC ALCOHOLISM.

Has effects upon: (a) The mental condition and nervous system; (b) The tissues, causing degeneration of cells and fibrosis. Beer especially tends to produce obesity. Patient feels worse in morning before mitigation by further alcohol.

MENTAL CHANGES.—Concentration, memory, and judgement deficient. *Carelessness of clothes.* Irritability often marked. *Epileptic fits* may occur.

FACIES.—Congested. Venules dilated. Nose large and red; may be 'acne rosacea'. Conjunctivæ watery; often icteroid.

Alcoholism, Chronic, continued.

ALIMENTARY SYSTEM.—Tongue furred, breath heavy. Head-ache. Nausea and lack of appetite, especially in the morning. Constipation. Chronic gastritis.

VOICE often husky : or, in gin drinkers, shrill.

TREMOR of hands and tongue.

Other important effects are :—

MULTIPLE PERIPHERAL NEURITIS (q.v.).

CIRRHOsis OF LIVER.—Hæmatemesis is common. Also fatty cirrhosis of liver : especially with malt liquors.

CIRCULATORY SYSTEM.—Heart : fatty degeneration common. Arteriosclerosis.

KIDNEYS.—Chronic nephritis common.

MORBID ANATOMY OF CENTRAL NERVOUS SYSTEM.—Changes slight. In nerve cells : experimentally chromatolysis, disintegration of Nissl's granules ; but lesions are *not permanent*, and recover on remitting alcohol. Chronic hæmorrhagic pachymeningitis with adhesion of dura not uncommon.

Tuberculosis and pneumonia frequent, and mortality high.

Treatment.—Effective only in an institution. Basis :—

WITHDRAWAL OF ALCOHOL BY 'TAPERING'.—For a few days rapidly diminishing quantities are given.

ATROPINE AND STRYCHNINE.—Increasing amounts, up to full doses in about 3 weeks, then diminishing.

SUBSEQUENTLY ENTIRE ABSTENTION.—Relapses common.

SEDATIVES.—Paraldehyde ʒiij or medinal gr. x, or chloral (gr. xx to xxx) and bromide : may be necessary for insomnia, but not to be given as routine.

PSYCHOLOGICAL METHODS.—Often useful.

IN MILD FORMS, a stomachic mixture is useful :—

R	Pot. Bromidi	gr. x	Tinct. Capsici	℥vj
	Tinct. Hyoscyami	℥xxx	Aq. Menth. Pip.	ad ʒj
	Tinct. Nuc. Vom.	℥v		

t.d.s. before meals.

3. DELIRIUM TREMENS.

Occurs in *persistent drinking*, generally under stimulus of temporary unusual amounts, or sudden cessation, or shock. Pneumonia and fractures frequently result from alcoholism, and lead to delirium.

ONSET.—Never sudden. *Insomnia*, depression, and restlessness for few days. May be hallucinations of animals, at this stage *recognized as imaginary*. Also bad dreams.

DELIRIOUS STAGE.—

NOISY DELIRIUM.—Loss of orientation of time and place.

HALLUCINATIONS OF SIGHT.—Rats, snakes, loathsome forms. Characterized by : (a) Terror ('the horrors') ; (b) Animals creeping over body ; (c) Animals numerous.

HALLUCINATIONS OF SOUND not common.

TREMORS.—Especially hands and tongue.

INSOMNIA.

Tongue : thick fur. *Pulse* : rapid. *Temperature* : 100° to 102°.

PROGRESS.—

1. **RECOVERY.**—Usually following a long sleep. Duration of delirium two to five days. Subsequent hazy memory of occurrence, but often distinct recollection of hallucinations. Korsakow's syndrome may remain.

2. **INSOMNIA PERSISTS.**—Passes into condition of 'wet brain', or prostration and cardiac failure.

MORTALITY.—High with pneumonia: otherwise usually recovery. Occasionally suicide.

Diagnosis.—Simple, but examine for pneumonia and fractures.

Treatment.—

GENERAL TREATMENT.—Indications are to procure rest and support the heart. *Confine to bed* in quiet room. Restraint by tactful nursing often necessary; may be accomplished by sheets fastened across ankles and across chest. *Alcohol:* Withdraw at once unless patient is old or weak, when withdraw rapidly in thirty-six hours. *Aperient:* Calomel gr. ij to v. Hot bath soothes, or if high temperature, cold packs. Emetics weaken heart.

CARDIAC WEAKNESS.—Common. Strychnine or coramine injections.

DIET.—Milk and eggs, every two or three hours (never waken).

SEDATIVES.—As in chronic alcoholism. Also:—

1. Hyoscine hydrobromide: inject gr. $\frac{1}{100}$ to $\frac{1}{25}$, with morphia gr. $\frac{1}{4}$ to $\frac{1}{2}$. Especially in severe delirium in young subjects.
2. Apomorphine: inject gr. $\frac{1}{10}$ to $\frac{1}{5}$. Quiets a truculent subject. Can be combined with hyoscine.

IN CONVALESCENCE.—Hyoscyamus and capsicum mixture as in *CHRONIC ALCOHOLISM*, p. 310.

4. VARIOUS MANIFESTATIONS.

1. **Korsakow's Syndrome or Psychosis.**—Only in persistent alcoholism, usually in middle-aged 'tipplers'. Not uncommon.

ONSET of mental condition may be: (a) Gradual; (b) Sudden; (c) Following mild delirium tremens.

SYMPTOMS.—Two factors:—

1. **PECULIAR DEFECTS OF MEMORY.**—(a) Loss of orientation of time and place, e.g., last week's event put years ago, environment outside the room door forgotten; (b) Loss of memory of periods, mainly recent, the irregular gaps being filled with complex fabrications. Patient often forgets immediate relatives. Yet intellectual reasoning is often surprisingly correct.

2. **MULTIPLE PERIPHERAL NEURITIS.**—May precede or follow the onset of mental disturbances. May be absent.

COURSE AND PROGNOSIS.—Very prolonged. If alcohol is withheld, mental improvement continues for months or years, but probably is never complete.

TREATMENT.—Symptomatic.

Alcoholism—Various Manifestations, *continued*.

2. '**Wet Brain**' (*Alcoholic Serous Meningitis*).—Only in chronic alcoholism, usually following delirium tremens. The noisy delirium changes to low and muttering type. Pallid. Prostrated. Lies on back, extending arms and hands towards ceiling. Tremor marked. No paralysis or optic neuritis. May progress to coma with rigidity of muscles and neck.

TERMINATION.—(i) Death from cardiac failure or pneumonia, mortality at least 50 per cent; (ii) Slow partial recovery.

MORBID ANATOMY.—Serous fluid in meninges: a transudate, and not true meningitis.

3. **Acute Hallucinosiis**.—Auditory hallucinations and ideas of persecution: delirium slight. Suicide frequent. Forms merge into delirium tremens.

4. **Alcoholic Automatism**.—May follow even a mild debauch with previous alcoholism, head injuries, epilepsy, or sunstroke. Automatism for various periods: journeys or business often performed: suddenly 'wakes up' days later, oblivious of interval.

5. **Dipsomania**.—Periodic impulse for an alcoholic debauch. May be non-alcoholic in intervals. Causes various; may be a recurring psychosis or depression with increasing craving until irresistible. Intervals tend to shorten and chronic alcoholism tends to develop.

TREATMENT.—Apomorphine: inject gr. $\frac{1}{16}$ to $\frac{1}{8}$: may abort craving.

6. **Relation to Insanity, etc.**—Chronic alcoholics may drift into dementia, but alcoholism accounts for only small proportion of insanity.

5. SPECIAL FORMS OF ALCOHOL POISONING.

Methyl Alcohol (*Wood Alcohol*).—Used as an adulterant in cheap spirits, etc.

CHARACTERISTICS.—

1. **ONSET OF SYMPTOMS**.—With moderate doses, may be delayed for 24 to 72 hours, or return severely after such interval. Ordinary symptoms of alcoholism. Attacks of intense dyspnoea with cyanosis (air hunger).

2. **BLINDNESS**.—Few severe cases escape. Stages are: (a) Bilateral total blindness: retrobulbar neuritis: few hours or days after intoxication. (b) Partial recovery. (c) Permanent blindness develops with optic atrophy: days or weeks later. In milder types: central scotomata, contraction of visual fields.

3. **UNCONSCIOUSNESS**.—Frequently passing into coma. Coma practically always fatal.

4. **FORMIC ACID** present in the urine.

TREATMENT.—Stomach wash, within twelve hours of ingestion. Sodium bicarbonate \mathfrak{zj} two-hourly by mouth for six doses, or intravenously.

Absinthe.—Acute or chronic excess causes convulsions. Chronic excess causes neuritis, hyperæsthesia, and hallucinations also.

CHAPTER LVII.

OPIUM POISONING. MORPHIA HABIT.

Acute Opium Poisoning.—Usually from suicidal intentions.

SYMPTOMS.—

COMA.—Profound : onset gradual.

PUPILS.—Contracted : pin-point (may dilate in final stage).

RESPIRATION.—Slow. Cyanosis.

Skin moist. Temperature normal. Plantar reflex flexor.

TREATMENT.—(Acute effect of opium is mainly on the respiratory centre. Morphia, even when injected, is excreted into the stomach and reabsorbed.)

INDICATIONS.—(i) Wash out stomach hourly with pot. permanganate 1-1000, leaving a few ounces each time ; (ii) Artificial respiration when and as long as necessary. Enemata of hot coffee.

Morphia Habit Addicts.—Subjects usually of psychopathic tendencies. More rarely commenced for pain ; assertion to be received with caution. Generally the dose has to be increased gradually. Several months elapse before habit established and symptoms commence.

APPEARANCE.—Prematurely aged, sallow, emaciated, hair thin and gray.

PUPILS.—Dilated or unequal, except under a dose, when contracted.

DEMORALIZATION.—Characteristic. Concentration deficient. Irritable. Unreliable. May be itching. Digestion and nutrition impaired.

ON WITHDRAWAL OF DRUG, or as effects of dose pass.—Lassitude and mental depression. Nausea, vomiting, and abdominal pains. *Fatal collapse frequent.* Suffering is extreme, and craving for drug so intense that subject will adopt any conceivable means to obtain it. Insomnia and nocturnal hallucinations occur, always terrifying ; most commonly of sight. Restlessness. Pulse and respiration slow. Constipation extreme. Sensory disturbances common, as hyperæsthesia of feet. Gradually, in absence of drug, disturbances subside and convalescence commences.

Treatment.—In morphia habit, drug no longer gives pleasure, and most subjects desire, but dread, to stop it. The sufferings are so intense that practically one may say *none can withstand them in absence of regular treatment in a home or institution.* Original cause to be ascertained and treated if possible, whether organic or psychopathic.

METHODS OF TREATMENT.—Without other drugs, sudden withdrawal unjustifiable, from frequency of fatal collapse : even with gradual withdrawal, sufferings intense. No method is ideal, and different authorities uphold various systems.

Morphia Habit—Treatment, continued.

SUDDEN WITHDRAWAL: HYOSCINE METHOD.—Inject hyoscine hydrobromide gr. $\frac{1}{100}$, and subsequently gr. $\frac{1}{200}$ hourly until mild delirium and dilated pupils; then every two or three hours up to forty-eight hours to maintain delirium. No morphia given. On recovery of consciousness, has lost craving for drug. Subsequently, inject pilocarpine gr. $\frac{1}{2}$ and repeat several times; this causes sweating and aids elimination of hyoscine.

GRADUAL WITHDRAWAL.—Morphia is more gradually replaced by atropine, hyoscine, or hyoscyamus. Insulin and other drugs also in use.

AFTER-TREATMENT.—General health is regained with surprising rapidity, but must be aided by exercises, full diet, and good air. Appetite may be excessive. Bowels need regulation. Relapses common in spite of precautions.

CHAPTER LVIII.**COMA.****Methods of Investigation.—**

A. GENERAL HISTORY AND DATA.—Obtained from friends and others.

PREVIOUS HISTORY.—(i) Existence of *any form of disease*, e.g., renal, diabetic, nervous, or epileptic; (ii) Previous similar attacks; (iii) Alcoholism or other drugs; (iv) Prodromata, e.g., headache, giddiness, vomiting, or convulsions; (v) Drugs found with patient.

ONSET OF COMA.—(i) Injury; (ii) Alcohol; (iii) Rapidity of onset, convulsions, and general account.

B. EXAMINATION OF PATIENT.—

APPEARANCE.—Congestion; cyanosis; respiration—depth, rate, stertor; blood on lips.

Signs of Injury.—Examine skull for fracture; ears and nose for blood or meningeal fluid; subconjunctival hæmorrhages. Also trauma and fractures elsewhere. Needle pricks (insulin or drugs).

PARALYSIS.—Especially *unilateral*. (May be simulated by fractures.) Note: (i) The cheeks puffed out on paralysed side; (ii) Flaccidity of paralysed limbs, drop 'dead'; (iii) Conjugate deviation of eyes and head; (iv) Reflexes, tendon and abdominal, absent on paralysed side, and Babinski's sign present. Neck rigidity.

PUPILS.—Size, equality, reaction to light.

BREATH.—Alcohol, acetone.

HEART.—Presence of murmurs, etc. *Condition of pulse and arteries.*

REFLEXES.—*Note* : Bilateral extensor plantar response may be present in most forms of deep coma except diabetic.

TEMPERATURE.

URINE.—Sugar, albumin.

Special examinations :—

FUNDI.—Albuminuric retinitis, optic neuritis.

BLOOD-PRESSURE.

LUMBAR PUNCTURE.—Withdraw few c.c. only : dangerous if intracranial pressure high.

GASTRIC CONTENTS.—To be preserved if poisoning suspected.

BLOOD-SUGAR.

Causes.—Most cases admitted to hospitals are due to :—

1. **ALCOHOL.**

2. **INTRACRANIAL VASCULAR LESIONS.**—Especially meningeal and cerebral hæmorrhage.

3. **INJURY TO HEAD AND SHOCK OF TRAUMA.**

Other causes :—

EPILEPSY.

SYNCOPE.—Fainting, cerebral anæmia, Stokes-Adams disease.

NERVOUS LESIONS.—Meningitis, encephalitis, intracranial tumour, abscess or embolus (rarely), sinus thrombosis. Rarely dementia paralytica, internal hydrocephalus, lead encephalopathy.

OPIUM.—Also other narcotics : chloroform, chloral, bromide, veronal, carbolic acid, oxalic acid, carbon monoxide.

URÆMIA, ACIDOSIS, ALKALOSIS, AND HYPOGLYCÆMIA.—Nephritis, diabetes, eclampsia, hepatic diseases, etc.

Other occasional causes :—

SEVERE FEVERS.—Later stages. Enteric, typhus, dysentery, cholera. Yellow fever (cholæmia). Blackwater fever.

HÆMORRHAGE.—Internal or external. Gastric, duodenal, enteric, ectopic gestation, etc.

HEAT-STROKE AND MALARIA.—Also extreme cold.

HYSTERIA.

Differential Diagnosis.—

ALCOHOL.—Coma rarely complete. Respiration deep but not stertorous. Pupils dilated. No pyrexia. Alcoholic breath.

SHOCK.—*Skin* cold and cyanosed ; cold beads of perspiration. *Pulse* rapid. *Respiration* sighing. Temperature subnormal. With intracranial hæmorrhage, as shock passes rise of pressure may cause renewed unconsciousness with slow pulse.

CEREBRAL HÆMORRHAGE.—Onset sudden. Coma deep. Unilateral paralysis (*see above*). Pupils dilated : may be unequal (larger on affected side). Temperature normal. Note age, condition of arteries and heart, fundi. For localization of site, *see CEREBRAL*

HÆMORRHAGE. *Pontine hæmorrhage* : paralysis bilateral, pupils contracted, pyrexia, may be crossed paralysis. *Meningeal hæmorrhage* : history of injury, latent period, gradual onset of coma.

EPILEPSY.—Post-epileptic coma. Coma short, about one hour. History of previous attacks or signs of a fit, e.g., tongue bitten.

Coma—Differential Diagnosis, *continued*.

OPIUM AND MORPHIA.—Onset of coma gradual. *Pupils pinpoint. Respiration slow. Skin moist. Temperature normal. Plantar reflex flexor.*

NARCOTIC DRUGS.—Pupils dilated. Analysis of stomach contents, drugs, etc. In carbon monoxide poisoning, peculiar cherry-red appearance.

URÆMIA.—Onset of coma gradual. Pupils contracted. Respiration may be Cheyne-Stokes type. Note urine, fundi, blood-pressure, arteries. May be œdema. Prodromata usual: headache and vomiting.

DIABETES.—Air-hunger. Acetone in breath. Glycosuria, ketonuria. Eyeball soft. Prodromata usual: headache, anorexia, epigastric pain.

HYSTERIA.—Pulse and respiration normal. No cyanosis. Resists lifting of lids.

CEREBRAL EMBOLUS (rare cause).—Cardiac disease.

SEVERE HÆMORRHAGE.—Extreme blanching. Pulse very rapid.

MALARIA AND HEAT-STROKE.—Hyperpyrexia. In malaria, protozoa in blood.

CONCUSSION.—Pupils unequal. Other signs slight. (Concussion to be diagnosed with great caution during coma.)

Diagnosis in other conditions depends mainly on associated diseases, on prolonged observation, and other factors.

Note.—Alcohol, injury, and hæmorrhage often coexist: diagnosis difficult and catastrophes common; *treat all doubtful cases as serious.* Alcohol in breath is no guide.

CHAPTER LIX.

LEAD POISONING.

Lead poisoning may be acute or chronic, usually the latter. It arises from many causes, the most important being: (1) *Industrial*; (2) *Accidental*; (3) *Medicinal*; (4) *Adulterations*.

Industrial.—Lead miners, in carbonate mines only (Broken Hill): rare in metallic lead mines. Smelters, workers in white-lead factories, painters, plumbers, enamel-plate makers. Glaziers and potters. File makers. Accumulators. Ship-breakers (oxy-acetylene flame on painted plates).

Accidental.—

WATER, if slightly acid, dissolves lead rapidly, especially from new pipes. Old lead surfaces often have covering of lead carbonate: partially protective, but soluble in hot water. Water from peaty soil dangerous from presence of humic acid, which dissolves lead.

CIDER AND BEER, in contact with lead. The first morning drink from a bar may contain lead: drunk daily by a barman can produce poisoning.

Medicinal.—Rare, except diachylon taken as abortifacient.

Adulterations.—Lead chromate has been used as colouring in baking powder.

Dose.—Doubtful. Brouardel states that one milligramme ($\frac{1}{10}$ gr.) daily produces plumbism.

Metabolism.—

PATH OF ENTRY.—(1) *Intestinal tract*, from lead on hands or swallowed with saliva, etc.; (2) *Respiratory tract*, inhaled as dust; (3) *Skin*, practical importance slight.

IN BODY.—Closely resembles calcium metabolism. Circulates as colloidal phosphate. Is stored in spongiosa of bone as insoluble triple lead phosphate, $Pb_3(PO_4)_2$: liberated and excreted into blood in same method as calcium: over-liberation causes excess in blood and results in acute toxic symptoms.

EXCRETION.—Urine and fæces.

Etiology.—*Age*: Liability is greater in youth. *Sex*: Females are especially susceptible. Idiosyncrasy is marked (Oliver). Excess of alcohol predisposes.

Morbid Anatomy.—

ACUTE FORM.—Changes as in gastro-enteritis.

CHRONIC FORM.—Chronic catarrh of stomach and intestines. Cæcum and ascending colon may be dusky from lead deposited in mucous membrane (well seen in microscopic sections). Liver contains most lead. If paralysis, peripheral nerves show degeneration. Interstitial nephritis common.

CEREBRAL FORMS.—Oedema of brain and minute hæmorrhages.

ACUTE LEAD POISONING.

Rare: practically confined to large doses of lead acetate ('sugar of lead'). Vomiting and abdominal pain and symptoms of gastrointestinal irritation. Rarely fatal.

Treatment.—Empty stomach with tube or emetic. Aperients.

Lead Tetra-ethyl.—Produces encephalopathy and mental symptoms. No case from 'ethyl petrol'.

CHRONIC LEAD POISONING.

Effects of chronic lead poisoning are: (A) Certain general symptoms. (B) Three classical clinical types: (1) Colic; (2) Encephalopathy; (3) Paralysis. (C) Certain remote effects. May develop after exposure has ceased.

A. General Symptoms.—

ANÆMIA AND PALLOR. Teeth often carious.

CONSTIPATION. General lassitude; nausea and disturbed digestion; headache. May be cramps in legs and vague pains, and tremors of hands.

Lead Poisoning, Chronic, continued.

BLUE LINE ON GUMS.—(Is proof of exposure to lead but not of poisoning.) Near but not at margins of gums. Usually lower jaw. Due to H_2S from tartar forming insoluble black sulphide: hence commoner with carious teeth, and may be absent with good teeth. In deep layers of mucous membrane and not removable by brushing; in papillæ, hence line discontinuous under lens. May appear within a week of exposure. An external removable deposit may be present at margin. Duration at least three weeks after cessation of exposure.

BLOOD CHANGES.—'Saturnine cachexia.' Hæmoglobin and red cells diminished, 2,000,000 to 3,000,000 per c.mm. Reticulocytes high: lead acts on and hardens outer membrane producing *stippling of red cells* (basophilic degeneration). Normoblasts relatively numerous. Leucocytes, little change.

ABORTION.—Very common. Menstruation irregular.

B. Classical Clinical Types.—Usually preceded by general symptoms. Colic and encephalopathy are acute toxic manifestations due to sudden excessive liberation of lead from store in spongiosa.

1. **COLIC (Lead colic).**—Probably due to enterospasm. Pain paroxysmal, eased by pressure: abdomen firm and retracted. General distribution usual. Pyrexia rare. Pulse slow, often high tension and small. Constipation usually obstinate. Urine reduced. Duration three to ten days: recurs with further lead. Never fatal. Diagnosis from appendicitis by apyrexia and slow pulse. Abdominal muscles may be tender between spasms.

2. **LEAD ENCEPHALOPATHY.**—High mortality. Very rare with modern Factory Regulations. Onset acute.

TYPES.—(i) Epileptiform convulsions; (ii) *Acute mania*, violent; (iii) Delirium; (iv) Coma. *Optic neuritis* and atrophy may occur. Permanent insanity rare. Rarely resembles dementia paralytica, but is curable. In convulsive forms, cerebrospinal fluid is under pressure and contains lymphocytes.

3. **LEAD PALSY.**—Onset subacute. Occasionally previous tinglings, tender calves, etc., but usually not. With paralysis: rapid muscular atrophy, sensation normal, tremor common; reaction of degeneration develops. May be pains in joints. Types of paralysis:—

WRIST-DROP.—Paralysis of extensors of wrist and fingers. Bilateral. *Brachio-radialis escapes*: also extensor ossis metacarpi pollicis: all others supplied by musculospiral nerve affected. Extensor longus pollicis affected first, inability to extend terminal phalanges. When severe, prominence on back of wrist (Grübler's tumour). Is commonest type.

When following occur, are usually subsequent to above:—

BRACHIAL TYPE.—Duchenne-Erb or scapulo-humeral type.

Uncommon. Deltoid, biceps, brachialis anticus, and

brachio-radialis. Deltoid earliest and most severe: arm hangs to side. *Note*: When this type coexists with wrist-drop, brachio-radialis is thus affected.

RARE FORMS.—(a) Aran-Duchenne type: Small muscles of hand, viz., interossei, thenar and hypothenar eminences. Atrophy marked. May precede wrist-drop. (b) Peroneal type: 'Toe-drop.' Mainly in children. Tibialis anticus escapes.

GENERALIZED PARALYSIS.—Very rare. Usually commences as wrist-drop, and extends. Very rarely onset acute, resembling Landry's paralysis or acute febrile polyneuritis.

CRANIAL NERVES.—Practically never affected (except rarely optic neuritis occurs).

Prognosis.—Depends on extent and duration of paralysis. With treatment and removal from lead, recovery is good in early cases.

C. Remote Effects.—

ARTERIOSCLEROSIS and ancillary conditions, e.g., chronic nephritis and myocarditis, common, but relation doubtful.

GOUT.—Association formerly over-emphasized.

Diagnosis of Chronic Poisoning.—Principal characteristics:

- (1) Anæmia and cachexia; (2) Constipation; (3) Blue line; (4) Colic; (5) Wrist-drop (brachio-radialis escapes). Lead present in urine and fæces (by electrolysis, etc.).

Treatment.—Remove permanently from exposure to lead: recurrences common after one attack. Treat general health and anæmia.

ACUTE SYMPTOMS (colic and encephalopathy).—Object is temporarily to fix lead in the bones. Effected by:—

1. Inject intravenously (slowly), 15 c.c. of 5 per cent calcium chloride: repeat in 2 hours if necessary: causes rapid relief (may be vomiting).
2. High calcium intake. Milk, 4 pints daily: or calcium lactate gr. 30, t.d.s.

COLIC.—Warmth to abdomen. Inject atropine gr. $\frac{1}{100}$, morphia gr. $\frac{1}{4}$. Enema: saline aperients with belladonna.

ENCEPHALOPATHY.—Lumbar puncture.

CHRONIC ELIMINATION (in palsy and after acute symptoms subside).—Stimulation of slow excretion of lead from store in bone: many months with intervals. Effected by:—

1. Low calcium diet: 100 mgm. daily.
2. Ammonium chloride: gr. 15 (1 gramme) in glass of water, six times a day. Parathormone is less safe or efficient: pot. iod. is less efficient.

If toxic symptoms develop (nausea, headache, and acute forms), cease elimination and give high calcium diet temporarily.

Prophylaxis.—

FACTORIES.—Many laws in force for ventilation, cleansing, preventing dust, etc.

WORKMEN.—*Cleanliness*: wash hands before meals; weekly bath. Meal before work (protein hinders absorption of lead). Milk to drink (for calcium). Sulphuric acid lemonade. Aperients.

CHAPTER LX.

ARSENIC POISONING.

Opportunities for arsenic poisoning occur in many circumstances. (1) Mining and smelting; (2) In various arts for colouring purposes, e.g., wall papers, carpets, artificial flowers; (3) In tanning, hat making, and various processes connected with skins; (4) Medicinal; (5) For poisoning animal life, e.g., fly-papers.

COLOUR-MAKERS.—Produces both green and bright-red colours, e.g., Persian red.

WALL PAPERS, ETC.—Certain moulds (*Penicillium brevicaulis*, *Mucor mucedo*) produce a volatile organic arsenic compound.

MEDICINAL.—Formerly widely used in anæmia and other conditions, often in large doses over long periods; also as cosmetics. Chronic arsenical poisoning, industrial and medicinal, is now rare.

Elimination.—By all excretions and secretions, urine, fæces, milk. Present in hair and various tissues. Elimination is rapid. Chemical tests (Marsh and modifications) are of great delicacy. Before it was realized that traces might be present in a normal body, this delicacy led to judicial errors in murder trials, e.g., Marie Lafarge, Darval.

Action of Arsenic.—Toxic to all protoplasm, e.g., spirochaetes, man. In small doses, beneficial as a 'tonic': some stimulating action on bone-marrow, but no specific effects.

Morbid Anatomy.—

ACUTE POISONING.—Gastro-enteritis: stomach, duodenum, colon, and rectum; may be some ulceration, but not perforation. Fatty degeneration of liver, etc., absent or slight. Exhumed bodies show remarkable preservation.

CHRONIC POISONING.—Rarely fatal. Degeneration of peripheral nerves: atrophy of anterior horn cells.

Forms of Poisoning.—Mainly as: (1) *Acute*, murder; suicide, accidental. (2) *Chronic*, now rare. (3) Arsenobenzol derivatives and various compounds.

1. ACUTE ARSENIC POISONING.

Characterized by gastro-enteritis.

ONSET.—Interval of $\frac{1}{4}$ to $\frac{1}{2}$ hour after ingestion: rarely, a few hours.

SYMPTOMS.—Little or no taste if well diluted, or with food.

Pain in stomach: burning, agonizing: spreads over abdomen. *Vomiting* and then *diarrhœa*, violent and repeated. *Thirst* extreme. Temperature low. Pulse feeble. Restlessness. Constriction in throat. Cramps in calves: severe, but often absent.

PROGRESS.—Collapse and rapid death. Or symptoms remit and return, with death in twenty-four to forty-eight hours or rarely several days.

General resemblance to cholera: may be profuse *watery stools*.

TREATMENT.—Stomach tube. Mild emetic if vomiting absent (mustard $\frac{1}{2}$ ss to a tumbler). Milk to drink. Freshly prepared ferric hydrate (tinct. ferri perchlor. $\frac{1}{2}$ j in a glass of water; add magnesia, washing soda, or *dilute ammonia* $\frac{1}{2}$ j; strain off precipitate in handkerchief and dissolve it in a glass of hot water; give repeatedly). Morphia for pain.

MINIMUM FATAL DOSE.—Gr. ij.

2. CHRONIC ARSENIC POISONING.

Affects especially *skin, mucous membranes, and nerves*. May follow recovery from several large doses.

MILD EARLY SYMPTOMS IN MEDICINAL TREATMENT.—

(1) *Headache*, earliest; (2) *Conjunctivitis and watery eyes*; (3) *Silvery tongue* (may be absent); (4) *Nausea*. More advanced: flushings, nasal and respiratory catarrh, tingling of extremities.

CHRONIC SYMPTOMS.—

GASTRIC SYMPTOMS.—Nausea, vomiting, diarrhoea. Nutrition impaired.

CATARRH OF MUCOUS MEMBRANES.—(a) *Eyes*, conjunctivitis and chemosis, puffy eyelids; (b) *Nose, larynx, and mouth*; (c) *Lungs*, bronchitis.

SKIN LESIONS.

PERIPHERAL NEURITIS.

Last two groups form the special and diagnostic characteristics.

SKIN LESIONS.—

PIGMENTATION.—*Early and common*. 'Rain-spot' flecks. Affects areas exposed, subject to pressure, or previously pigmented. Yellow to deep brown. Buccal mucous membrane escapes (cf. ADDISON'S DISEASE). Fades partially on treatment, but not completely if severe.

KERATOSIS.—Soles and palms. Of all degrees: desquamation marked. 'Corns' may form. Occasionally gives rise to epithelioma.

HERPES.—Common. Is produced by no other drug.

ERUPTIONS.—Of numerous types: bullous, psoriasisiform, etc.

NAILS become brittle. **HAIR** falls out.

VASOMOTOR PHENOMENA.—Occasionally resembling erythromelalgia.

PERIPHERAL NEURITIS.—Both sensory and motor fibres; especially lower extremities.

1. **SENSATION.**—*Pain marked*: calves tender. Later, sensation lost,

2. **PARALYSIS.**—Lower extremities first, *especially toes*. All muscles, but extensors more than flexors. Atrophy rapid. Reaction of degeneration present. Knee-jerks absent. Deformities may follow.

Arms later and less often affected.

Chronic Arsenic Poisoning, continued.

MENTAL SYMPTOMS rare.

IN LONG-CONTINUED EXCESS.—Anæmia, wasting, cardiac weakness.

PROGNOSIS.—Improvement rapid unless condition very severe.

3. ARSENOBENZOL AND VARIOUS COMPOUNDS.

ATOXYL.—Often produces rapid optic atrophy within seven to ten days of injection.

FERROSILICON.—When moist, gives off AsH_3 and PH_3 . Many deaths occurred in ships and barges before recognition. Very toxic, causing collapse, jaundice, and death in a few hours.

ARSENOBENZOL PREPARATIONS.—(See p. 235.)

MANCHESTER BEER EPIDEMIC.—Arsenic was suggested by frequency of herpes (Reynolds). Arsenic was traced to glucose used in brewing: origin being from sulphuric acid prepared from pyrites containing much arsenic.

Diagnosis.—In cases of slight general ill-health, cardiac weakness, etc., diagnosis only by finding arsenic in excreta, hair, or suspected articles.

PIGMENTATION IN ADDISON'S DISEASE.—Buccal mucous membrane often affected. (See PIGMENTATION, p. 321.)

LEAD PALSY.—Affects upper extremities, certain muscles escape, sensation normal. No local pain. Special symptoms of lead poisoning present.

ALCOHOLIC NEURITIS.—Affects calves rather than toes. Often difficult. (See MULTIPLE NEURITIS.)

CHAPTER LXI.**VERONAL POISONING.**

Veronal is diethyl-barbituric acid, officially (B.P.) known as *barbitonum*. Only slightly soluble in cold water; more so in hot water. Bitter taste; unpleasant in milk. Powerful hypnotic. Dose: gr. v to x: gr. v sufficient for adult.

Acute Veronal Poisoning.

SYMPTOMS.—Single *excessive* dose produces drowsiness, headache, and may be ataxia and reeling gait; nausea unusual. Deep sleep follows, progressing to coma, cyanosis, and rapid, often stertorous, respiration. During coma, pyrexia common; may be physical signs suggesting pneumonia (may be erroneously diagnosed). From deep coma recovery rare.

FATAL DOSE.—In healthy adult 50 gr. is 'average minimum fatal dose'. Smaller doses often fatal with disease or other drugs.

TREATMENT.—

1. **STOMACH WASH.**—Especially valuable within four hours, owing to insolubility, but advisable even later. Leave in stomach hot strong coffee, 1 pint, with some milk and castor oil $\bar{5}$ j. Retain washings for analysis.
2. **STRYCHNINE.**—In full doses at short intervals.
3. **ALCOHOL.**—Inject intravenously 30 c.c. of 30 per cent solution until conscious.
4. **CISTERNAL PUNCTURE.**—Repeat if necessary.
5. **CARDIAC STIMULANTS.**—Coramine. Oxygen if cyanosis. If retention, catheterize bladder: retain urine for analysis, veronal rapidly excreted by kidneys.

AUTOPSY.—Signs of death from gradual cardiac failure—no characteristics. Cyanosis. Heart dilated, especially right side. Hypostatic congestion of lungs.

Veronal Habit.—Mental and psychical disturbances may develop. General condition said to suggest chronic alcoholism, with tremors, ataxy, and thick speech. Tolerance is slight, and an overdose is often fatal, especially with constipation or renal disease.

Barbiturate Poisoning.—Treatment as above for luminal, medinal, etc.

CHAPTER LXII.

COCAINE POISONING.

Cocaine is an alkaloid, methyl-benzoyl-ecgonine, obtained from the leaves of *Erythroxylon coca*. Used medicinally as a local anæsthetic. In addicts other drugs, e.g., alcohol and morphia, often complicate symptomatology. Fatal dose doubtful: idiosyncrasy very marked.

Acute Cocaine Poisoning.—

SYMPTOMS.—

MILD DEGREES.—Faintness, giddiness, rapid pulse and respiration; restlessness, nervous excitement, and anxiety; no pleasant sensations.

SEVERER DEGREES.—Nervousness and great restlessness. Pulse rapid and feeble. Pupils dilated. Perspiration, nausea and vomiting. Collapse may occur, with or without loss of consciousness. Respirations variable; may be slow, irregular, or Cheyne-Stokes, and with cyanosis. *Convulsions* may occur: often violent. Occasionally mania, but unconsciousness more frequent. Pulse often slow before death.

AFTER-EFFECTS.—Insomnia, giddiness, anæsthesias.

Acute Cocaine Poisoning, continued.

TREATMENT.—Recumbent. Stimulants: alcohol or coramine. Artificial respiration or oxygen for respiratory failure. Strong coffee enema. Wash out stomach if taken by mouth.

Cocaine Habit.—Usually by snuffing or hypodermic injection.

EARLY STAGES.—Usually taken intermittently. Pleasant sensations of exhilaration, mental power, and physical strength: subject talkative and happy.

LATER STAGES.—Rapid moral and physical degeneration. Subject pale and emaciated. Depressed and irritable; when under drug, voluble but disconnected. Insomnia. Muscular restlessness; may be irregular choreiform movements. Movements often clumsy. Paræsthesias, especially sensation of small foreign bodies under the skin, often at finger-tips. Mental changes: hallucinations of voices common, delusions of persecution; jealous, sexual, and obscene.

TREATMENT.—Institutional treatment is the correct remedy. Sudden and complete withdrawal is without danger. The hyoscine method (*see* MORPHIA HABIT, p. 314) may be used.

CHAPTER LXIII.

FOOD POISONING.

Diseases of many kinds may be conveyed by or arise from ingestion of food, but the term 'food poisoning', though not clearly defined, is usually applied to certain acute conditions, due to bacterial infection and characterized mainly by gastro-enteritis, often occurring in so-called epidemics or outbreaks, attacking a number of persons within a short space of time.

'**ENDOGENOUS FOOD POISONING**'.—Applied to results of consumption of substances normally poisonous, e.g., certain fungi.

'**PTOMAINE POISONING**'.—Formerly believed that by autolysis in meat or fish, or by putrefaction due to non-virulent bacteria, poisonous substances (ptomaines) were formed which caused food poisoning. These ptomaines were considered to result from protein disintegration, e.g., putrescine and cadaverine. Term now little used medically.

1. BACTERIAL FOOD POISONING.

Causes.—(1) Infection with bacilli; (2) Products of bacillary action (toxins).

Modes of Contamination with Bacteria.—(a) Animal infected and sick when slaughtered; (b) Food, during preparation for consumption, contaminated by human 'carrier' or by excreta of rats, etc. Most important modern epidemics arise from latter cause.

PRESENCE OF TOXINS.—Bacilli during growth often produce toxins, which may survive processes killing the bacilli, and later cause illness.

Infected food when consumed may be normal in appearance, taste, and smell: putrefaction may cause changes.

Substances Affected.—Pork, veal, and beef most commonly, mutton rare. Also milk.

Bacteriology.*—Bacterial food poisoning is nearly always due to either: (1) *B. aertrycke*, most commonly; or (2) *B. enteritidis* (Gaertner).

B. aertrycke.—Is identical with *B. suispestifer* (*B. cholerae suis*), the bacillus of hog cholera.† Agglutination reactions are identical with *B. paratyphosus B*, but differentiated by agglutinin absorption tests. *B. paratyphosus B* is not a cause of epidemic food poisoning, but on the Continent the two bacilli are apparently regarded as identical.

B. enteritidis (Gaertner).—Agglutination reactions distinguish from above organisms.

B. aertrycke, *enteritidis*, and *paratyphosus B*. are identical in morphological and cultural characteristics.

OTHER ORGANISMS.—Various organisms have been described and occasionally found in epidemics, e.g., *B. asiaticus* (very rare), *B. Morgan No. 1* (prevalent in summer diarrhoea of infants).

Note.—Bacilli of enteric group and other organisms may be spread by milk and food, and have thus caused large epidemics, but these are not usually included as 'food poisoning'.

Morbid Anatomy.—Acute gastro-enteritis; Peyer's patches unaffected, no ulceration. Bacilli often recoverable from bile and spleen. In non-fatal cases, affection is mainly of small intestine.

Symptoms.—Outbreak of food poisoning usually possesses following features: (1) Symptoms commence almost simultaneously amongst a number of those consuming the food; (2) Illness limited to those eating the food, but *not all necessarily become ill*; (3) In large outbreaks, every degree of severity is usually present; (4) In bacillary forms, excreta of patients are infective, and condition may spread subsequently as an epidemic, e.g., in institutions and camps.

LATENT PERIOD.—Variable, three to thirty hours.

ONSET.—Sudden. Abdominal pain and tenesmus, diarrhoea, nausea, and usually vomiting. Commonly: headache, cold sweats; often shivering, and syncope when severe. Cramp in muscles.

PROGRESS.—Initial symptoms usually the severest. Diarrhoea often continuous for few hours; rarely severe more than two to five days. Improvement usually rapid. Continued vomiting is most serious symptom, and present in most fatal cases.

* See also TYPHOID FEVER—IDENTIFICATION OF ENTERIC, DYSENTERY, AND FOOD-POISONING BACILLI, p. 32.

† Hog Cholera is more probably due to a filterable virus, and *B. suispestifer* is a secondary invader.

Food Poisoning, Bacterial—Symptoms, *continued*.

PHYSICAL SIGNS.—No characteristic. Tongue clean or slight fur. Abdomen tender but usually not rigid. Spleen not enlarged. No rash. Temperature: in severe cases often 99° to 102°, but may be apyrexial. Character of stools: blood and mucus rare, mucus never in masses as in dysentery. Blood occasionally while motions very frequent. Acetonuria if vomiting severe.

Sequelæ.—Regulation of bowels difficult: either obstinate constipation or recurrences of diarrhœa. Occasionally, appendicitis.

Mortality.—Low: 1 to 3 per cent. Vomiting usually persistent in fatal cases.

Diagnosis.—Numerous simultaneous cases in household or assembly of individuals. Diagnosis from: (1) *Dysentery*: by absence of mucus from stools and by specific organisms. (2) *Enteric fever*: by sudden onset and rapid maximum severity.

SPECIFIC DIAGNOSIS.—Bacteriological examination of stools and urine. Agglutination reactions with recognized strains. In an outbreak of any extent, many cases may give negative results, but a few positive examinations are sufficient to establish the cause.

Treatment.—First essentials are *warmth and fluids*, the latter by mouth or by intravenous salines.

EARLY STAGE.—Give castor oil (℥ss to ℥j). *For collapse*: stimulants.

DIET.—For twenty-four hours fluids only. As diarrhœa ceases, diet can be rapidly increased.

DRUGS.—Bismuth 100 to 150 gr. daily. Avoid morphia injections.

R	Bismuthi Oxycarb. gr. xx to xxv	|	Aq. Chloroformi	ad ℥j
	Tinct. Chloroformi et			
	Morphinæ Co. ℥v to x			

Every two to four hours.

Bismuth salicylate gr. x to xv is also a valuable remedy.

VOMITING.—If excessive, wash out stomach; give champagne; epigastric fomentation.

CONSTIPATION subsequently.—Liquid paraffin, ℥ij to iv. t.d.s., assisted by enemata.

Investigation of an Outbreak.—Note: (1) Clinical symptoms.

(2) Bacteriological examinations of excreta and serum reactions.

(3) Epidemiology: (a) date, time, and number of persons attacked;

(b) relations to any common meal, or consumption of same article of food, or food prepared by same person or persons. (4) Examination of residue of food consumed, especially bacteriological.

(5) Mode of preparation of food, cleanliness of kitchen, cooking, and apparatus employed. (6) Examination of cooks: (a) previous or present attack of diarrhœa; (b) bacteriological examination of excreta and serum tests, for identification of 'carriers'.

2. BOTULISM.

('Sausage Poisoning.')

Characterized by paralysis of cranial motor nerves and diaphragm. Due to toxins formed by a specific organism, *B. botulinus*. Very rare in British Isles; in Germany from partially cooked ham, and in America from canned vegetables.

Bacteriology.—

BACILLUS.—*B. botulinus* is a large, straight bacillus with round ends; possesses flagellæ, slightly motile. Gram positive. Strict anaerobe. Forms spores readily: these are destroyed at 120° C. in six minutes. Widely distributed: causes 'grass disease' in horses.

Two distinct strains of bacilli occur, A and B; differ in reaction to heat; produce specific antisera.

MODE OF ACTION.—Poisoning is due to toxins formed in food-stuffs, and not to the ingestion of bacilli.

Affected Substances.—Ham, salt or smoked (most commonly); sausages; any canned foods (meat, vegetable, fish, or fruit). Rancid smell may be present. Occasionally in duck's eggs.

Morbid Anatomy.—Not distinctive. No inflammatory changes.

Symptoms.—

LATENT PERIOD.—Usually 12 to 24 hours; rarely 36 to 48 hours.

ONSET.—Diplopia, extreme, is usual initial symptom. Generally difficulty in swallowing follows.

NERVOUS SYMPTOMS.—

1. **VISION.**—*Diplopia*; ptosis; paralysis of various ocular muscles. Pupils may be dilated; loss of accommodation.

2. **PHARYNGEAL PARALYSIS.**—Inability to swallow.

3. **LARYNGEAL PARALYSIS.**—Varies from difficulty of speech to complete aphonia.

4. **PARALYSIS OF DIAPHRAGM.**

Other cranial motor nerves may be affected.

GASTRO-INTESTINAL SYMPTOMS.—Usually absent. Occasionally vomiting (suggests heavy dose) and mild abdominal pain.

OTHER SYMPTOMS.—Dizziness. Insomnia. Muscular weakness. Constipation.

No pyrexia. No headache or pain. No changes in fundus.

No sensory changes. Deep reflexes unaltered. No tremors.

No rash. Sphincters not affected. Spleen not enlarged.

Progress.—In severe cases, progress without remission. Death from paralysis of diaphragm in first or second week. Conscious to the end: no coma. Mortality in severe forms 70 per cent, but all grades of severity occur.

Diagnosis.—Usually simple, from clinical symptoms and affection of several individuals.

Treatment.—Alcohol freely. Strychnine. Antiserum (to respective strain): intravenous injection, 20 to 50 c.c.: repeat daily. Stimulants. Wash out stomach.

3. SHELL-FISH POISONING.

Idiosyncrasy marked in all varieties ; children specially liable.

Mussel Poisoning.—

CAUSE.—*Mytilotoxin*, a ptomaine, produced by bacteria : isolated by Brieger. Not destroyed by heat, and poisonous after cooking.

SYMPTOMS.—Onset very rapid, often ten to fifteen minutes after ingestion. Acute collapse. Giddiness, coldness and lividity, rapid feeble pulse. No gastro-enteritis. Itching intolerable, either at onset or later. Urticaria common, twenty-four to forty-eight hours. Duration short, but death may occur in few hours. Less commonly, symptoms of acute gastro-enteritis.

TREATMENT.—Bed, warmth, and stimulants freely.

Pass *stomach tube* and wash repeatedly with large quantities of water ; finally leave in stomach castor oil (3j). (Emetics inferior to stomach tube.)

Convalescence rapid, one to two days, but some weakness remains.

Crabs, Lobsters.—Idiosyncrasy marked. Gastro-enteritis commoner ; collapse rare.

Oysters.—Disease from presence of enteric or Gaertner's bacillus, or both. Oysters 'spoil' readily, producing gastro-enteritis.

4. MUSHROOM POISONING.

Idiosyncrasy not uncommon, even to 'edible' varieties.

SYMPTOMS.—(1) Restlessness or actual delirium ; (2) Dilatation of pupils and disturbance of vision ; (3) Slow pulse ; (4) Diarrhoea and vomiting. Symptoms are akin to poisoning by muscarine (which occurs in many mushrooms), but are rarely all present.

SPECIAL TREATMENT.—Wash stomach repeatedly (fungi adhere to wall). Inject atropine sulphate gr. $\frac{1}{60}$: repeat in half hour if necessary (antidote to muscarine).

5. GRAIN POISONING.

Ergotism.—Due to meal made from rye on which ergot fungus (*Claviceps purpurea*) has grown. Chronic condition. Two clinical types, formerly attributed to sphacelinic acid and cornutin respectively :—

GANGRENOUS OR TROPHIC TYPE.—Usually toes or fingers. Preceded by tingling, pain, and anæsthesia.

CONVULSIVE TYPE.—Preliminary tingling. Then spasms, with flexed arms and extended legs : duration hours or days. Death may occur in convulsions. If chronic, dementia may develop, or posterior sclerosis as in tabes.

Lathyrism.—Due to certain vetches when powdered (chick-pea) being added to cereals. In India, and formerly in Italy. Ascribed to a toxalbumose, comparable with ricin and abrin.

SYMPTOMS.—Onset with sudden severe lumbar pains ; later girdle pains ; progresses to spastic or ataxic paraplegia.

Section IV.—DISEASES OF METABOLISM AND DISEASES OF DEFICIENCY.

A. DISEASES OF METABOLISM.

CHAPTER LXIV.

GOUT.

(*Podagra*.)

A disorder of metabolism of purin bodies resulting in an excess of uric acid salts in the blood, and characterized typically by attacks of arthritis associated with the deposition of sodium biurate crystals.

Etiology.—

AGE.—Onset commonest between 35 and 50 years; rare before 30.

SEX.—Males predominate.

HEREDITY.—Important factor.

ENVIRONMENT.—Especially among richer classes.

PREDISPOSING FACTORS.—(1) *Alcohol*: Beer, port, and sweet wines: less with spirits. No great frequency in cirrhosis of the liver. (2) *Food*: Constant rich diet. *Lead*: Now negligible.

EXCITING CAUSES OF ATTACK.—Often doubtful. Local trauma common. May follow rich meal or drink, mental worry, cold.

Morbid Anatomy.—

JOINTS.—Deposits of acicular crystals of sodium biurate. *Earliest site*: *Articular cartilages*, immediately below surface. If dissolved out by water, cartilage remaining is but little changed. In later stages, peri-articular deposits in ligaments, tendon sheaths, etc., with erosion of cartilage and deformity of joints. Synovial fluid may be turbid with crystals. *In acute attack*, signs of hyperæmia, inflammation, and joint effusion.

TOPHI.—Deposits of sodium biurate in other sites, especially where circulation is stagnant or near fibrous tissues: peri-articular or helix of ear, most commonly. Deposits may be scattered throughout the body.

KIDNEYS.—Rarely normal. Changes are: (1) *Chronic interstitial nephritis*: small pale kidney ('gouty kidney'). Less commonly, large red arteriosclerotic. (2) Deposits of urates: intertubular, irregular, or in streaks of pyramids: visible macroscopically.

CIRCULATORY SYSTEM.—*Arteriosclerosis* common.

Chemical Pathology.—See Chapter LXV, p. 333.

Gout, *continued.*

SYMPTOMS.

Clinical manifestations are considered as follows: (1) Acute; (2) Chronic; (3) Irregular; (4) Metastatic gout; (5) Complications.

Acute Gout.—

PREMONITORY SYMPTOMS.—Unusual in first attack, previous health being usually good.

ONSET.—Sudden (especially earlier attacks). In *early morning*.

PAIN.—Intense, as if 'seized in a vice'.

JOINT.—*Swollen, shiny, red, and tender.* Veins near distended.

(Later, may pit and desquamate: in larger joints effusion.)

PROGRESS.—During succeeding day, general malaise and irritability, but pain easier. Temperature 100° to 103° . Pain returns at night. Attack lasts about a week: pain gradually lessens, while swelling often increases. Other joints may become affected, prolonging attack to two or three weeks. *Blood*: Leucocytosis 20,000 to 25,000; polymorphs 80 per cent.

JOINTS AFFECTED.—*Great toe* commonest, at proximal joint. Tarsus, ankles, knees, fingers, especially thumb, and wrist. Uncommon: elbows, shoulders, hips. Very rare: jaw, sternoclavicular joint.

URINE.—Scanty. High colour. Often trace of albumin and few casts. Deposit of urates and uric acid variable.

Health good following attack. Recovery from first attack complete. Interval between earlier attacks often many years.

Chronic Gout.—

PREMONITORY SYMPTOMS.—Common, e.g.: (a) Gastric flatulence and acidity; (b) 'Pricking' in joints; (c) Irritability of temper.

PROGRESS OF DISEASE.—Acute attacks become more frequent. Intervals irregular but shortening: one or two yearly, spring and autumn. Often returns in original joint: then subsequently other joints, or simultaneously several joints affected. Temperature often normal. Attacks of gout may diminish as deposits grow, and often cease in later years.

JOINTS.—Recovery less complete after each attack; become irregular from deposits of sodium biurate in ligaments, capsule, and under cartilage. Pain persists between attacks.

'**TOPHI**'.—*Chalk stones.* 'Tophaceous gout'. (1) Peri-articular. Form masses. Skin may slowly ulcerate and expose deposit. (2) Abarticular. Especially in helix of ear. Less common sites: extensor surface of forearm, sclerotics, etc.

URINE.—Depends on renal condition. (For uric acid excretion, see *CHEMICAL PATHOLOGY*, p. 333.)

Irregular Gout (*Suppressed gout* or '*gouty diathesis*').—Many symptoms formerly attributed to 'irregular gout' are now ascribed to associated lesions: but it is not impossible that gout is a factor. Such symptoms include:

ALIMENTARY SYSTEM.—Dyspepsia, constipation, and pharyngitis.

AFFECTIONS OF THE SKIN.—*Eczema*, especially of, and behind, ear. Pruritus.

AFFECTIONS OF THE EYE.—Itching of the eyeballs. Conjunctivitis. *Iritis*. Possibly glaucoma.

Retrocedent or Metastatic Gout.—During an acute attack, local condition may suddenly abort, while symptoms appear such as coma or delirium, also cardiac and gastric symptoms.

Complications and Sequelæ.—

RENAL.—Chronic interstitial nephritis in chronic cases.

CIRCULATORY SYSTEM.—Arteriosclerosis common. Thrombosis not uncommon: usually lower limbs.

PULMONARY SYSTEM.—Emphysema and chronic bronchitis common. Asthmatic attacks occur.

GLYCOSURIA.—Common in fat subjects: diabetic symptoms rare.

GRAVEL AND CALCULI.—*Urethritis* not uncommon: may follow connection.

DIAGNOSIS.

In Acute Attacks.—Usually simple: (1) *Arthritis*, often recurrent, in big toe or single joint; (2) Sudden onset; (3) Joint *swollen, shiny, red, and tender*; (4) Patient a full liver.

In Chronic Forms.—More difficult. Consider: (1) Patient's mode of living; (2) Character of early attacks; (3) *Tophi*; (4) Condition of joints—X rays show deposits are peri-articular; (5) Uric acid in blood: in gout at least 3 mgm. per cent.

Diagnosis from:—

ARTHRITIS DEFORMANS.—Usually multiple joints from onset: Osteophytic growths: wasting of muscles. In upper extremity, ulnar deflection; wasting of interossei muscles: Heberden's nodes. X rays show atrophy of bone.

RHEUMATIC FEVER.—Age under thirty. Fever higher. Attacks larger joints. Joints not red or shiny. Gout never causes endocarditis.

SYNOVITIS.—Gonorrhœal, pyæmic, and traumatic.

TREATMENT.

Acute Gout.—

LOCAL TREATMENT OF LIMBS.—Elevate. Wrap in cotton-wool. Warm fomentations of sod. bicarbonate (3j to Oj), with tinct. opii ʒj. Cradle to support bed-clothes.

DIET.—Fluids freely. Milk diet.

BOWELS.—Calomel gr. 3-5 at night with saline aperient in morning.

Acute Gout—Treatment, continued.

DRUGS.—*Colchicum* eases the pains and shortens the attack : mode of action unknown. Administration not to exceed four days, being powerful gastro-intestinal irritant. Example :—

R	Tinct. Colchici	℥xv	|	Mag. Sulphat.	gr. xxx
	Pot. Citratis	gr. xxx	|	Aq. Menth. Pip.	ad ʒj

Every two hours for 4 doses, then every four hours.

If necessary, replace by sodium salicylate subsequently.

PAIN.—Barbitone or aspirin. Avoid morphia if possible.

Chronic or Irregular Gout.—

DIET.—Meals should be simple, not necessarily dull. General reduction more important than discrimination concerning certain articles, but all 'rich' substances excluded.

PROTEIN.—Meat and fish allowable. Chicken, white meat, and fish best, also bacon : butcher's meat in moderation. *Exclude* articles rich in purins, especially sweetbreads, liver, rich meat soups and sauces, duck, goose, rich game, and salmon.

CARBOHYDRATES AND FATS.—Definite restriction only necessary if *dyspepsia*. Butter and fats given freely ; cheese moderately. *Exclude* rich pastry and sweets, boiled new potatoes.

VEGETABLES.—Green vegetables freely : *exclude* spinach, rhubarb, and asparagus.

FRUIT.—Give freely, except strawberries.

FLUID.—A glass of water to be sipped first thing in the morning and at night. No coffee. Weak tea.

ALCOHOL.—*Entire abstinence preferable*. If necessary, whisky or still white wine. *Exclude* beer, champagne, port, and sweet wines.

PURIN-POOR SUBSTANCES.—Milk, white bread, potatoes, eggs, butter, cheese, rice, cereals, green vegetables.

MEDICINAL TREATMENT.—Objects : (i) To keep uric acid in solution, e.g., by alkaline carbonates ; (ii) To increase excretion of urates, e.g., by salicylates.

ALKALINE SALTS.—Mineral waters, or pot. citratis gr. xv in tumbler of water, several times daily for prolonged periods.

GUAIACUM.—In chronic gout with pains. Pot. iodide given simultaneously. Examples :—

R Guaiacol Carb. gr. v cachets, with :—

R	Pot. Iodid.	gr. x	|	Aq. Menth. Pip.	ad ʒj
	Tinct. Nuc. Vom.	℥v	|		

Three times a day.

SALICYLATES.—Increase output of uric acid : dosage, etc., as in rheumatism.

ATOPHAN (phenoquin, cinchophen).—Increases output of uric acid. Good results. Not in acute stages. Powerful drug, producing atrophy of liver if given too continuously. Give gr. xxx once daily for four days, then interval of 10 days with alkalis : repeat course : then interval for several months.

BOWELS.—Regular action important. Calomel or colocynth pill at night and saline aperient in morning.

R Calomel gr. j | Ext. Colocynth. Co. gr. iv

Or,

R Euonymin gr. ij | Pil. Colocynth. Co. gr. iss
Ext. Hyoseyami gr. j |

/ **LOCAL TREATMENT OF JOINTS.**—If much pain, as for acute gout. *For chronic joints:* Massage, lightly. Radiant heat baths and hot air. Electricity and cataphoresis.

SPA TREATMENT.—Of benefit in chronic cases, owing to routine and regular life. Among others are:—

BRITISH SPAS.—Bath. Buxton. Harrogate. Llandrindod. Strathpeffer.

UNITED STATES.—Bedford. White Sulphur Springs. Saratoga.

FRANCE.—Aix-les-Bains. Contrexéville.

CHAPTER LXV.

CHEMICAL PATHOLOGY OF GOUT.

Three essential facts in gout are established: (1) Presence of excess of uric acid in the blood; (2) Deposition of sodium biurate in articular and other tissues; (3) Diminished excretion of uric acid in the urine during a paroxysm. No other point is beyond discussion, and the first two of these are not pathognomonic of gout, since they occur in other conditions. Wollaston, 1797, proved gouty deposits contained uric acid. Garrod, 1847, demonstrated presence of uric acid in gouty blood.

THE PURIN BODIES.

Abnormal metabolism of the 'purin bodies' produces the phenomena of gout. The occurrence of this abnormal metabolism is probably not immediately due to any abnormality of the purin bodies themselves, but to some remoter cause, possibly to some error in a protein with which they are normally combined when circulating in the blood, or to some error in the ferments concerned in their metabolism; of such questions practically nothing is known.

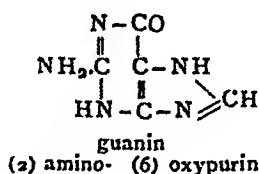
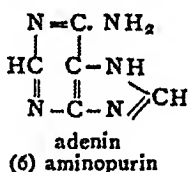
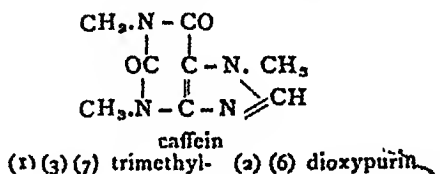
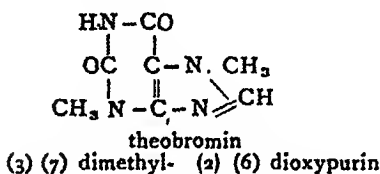
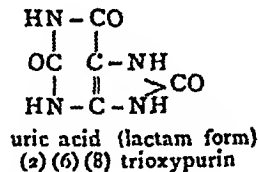
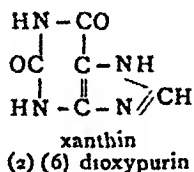
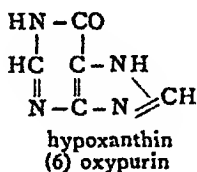
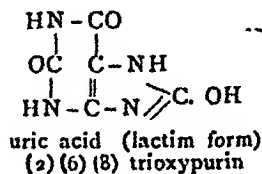
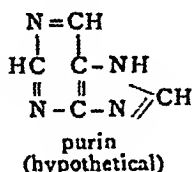
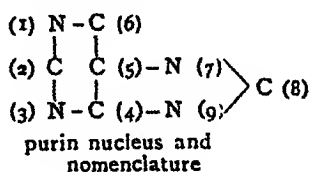
PURIN BODIES.—Form three groups, of which the following enter into human metabolism.

1. **OXYPURINS.**—(i) Hypoxanthin (monoxypurin). (ii) Xanthin (dioxypurin). (iii) Uric acid (trioxypurin, $C_5H_4N_4O_3$).
2. **AMINOPURINS.**—(i) Adenin (aminopurin). (ii) Guanin (amino-oxypurin).
3. **METHYLPURINS.**—(i) Theobromin (dimethyldioxypurin). (ii) Caffein (trimethyldioxypurin).

CONSTITUTION OF THE PURIN BODIES.—The purin bodies possess a common skeleton, viz., the heterocyclic ring named by

Gout—Chemical Pathology—The Purin Bodies, *continued*.

Fischer the 'purin nucleus'. The structural formulæ exhibit the relationships:—



Source of the Purin Bodies Excreted in Man.—Two sources:
(1) Exogenous; (2) Endogenous.

EXOGENOUS PURINS.—Ingested with food. Only certain food-stuffs affect purin excretion:—

1. **NUCLEIN-CONTAINING SUBSTANCES.**—On decomposition these produce aminopurins, convertible into uric acid in the body. Specially abundant in the thymus (adenin) and pancreas (guanine).
2. **MUSCLE.**—Contains the oxypurins xanthin and hypoxanthin, convertible into uric acid in the body. Specially abundant in meat extracts.
3. **CAFFEIN OR THEOBROMIN (cocoa).**—Methylpurins. *Increase purin excretion, but not convertible into uric acid in the body.*

ENDOGENOUS PURINS.—Arising from metabolism of tissues.
Two main sources:—

1. **MUSCLE METABOLISM.**—Produces xanthin and hypoxanthin. Increased by exercise.
2. **NUCLEIN.**—Normally, and also in gout, of less importance than muscle. In leukaemia and leucocytosis, is origin of much uric acid.

DAILY EXCRETION.—*Purin-nitrogen* in grammes: (1) Exogenous, 0.3 to 0.5; (2) Endogenous, 0.1 to 0.2.

Probably half the endogenous purins arising from metabolism are decomposed into urea, etc., in the tissues and do not reach the urine as purins. Total daily uric-acid nitrogen about 0.6 grammes.

Formation of Purin Bodies and Uric Acid in the Tissues.—

From nuclein, both of food and of tissues, by action of succession of specific ferments (enzymes). (i) *Nuclease*: frees adenin and guanin from nuclein. Distribution in tissues almost universal. (ii) *Desamidase*: converts adenin and guanin into hypoxanthin and xanthin. Distribution same as nuclease. (iii) *Oxidase*: converts hypoxanthin and xanthin (from any source, nuclein or muscle) into uric acid; this takes place in the liver.

Most animals readily oxidize uric acid into (finally) CO_2 and NH_3 by the ferment *uricase*: the presence of this in man is unproved, and man, possibly owing to its absence, has difficulty in disposing of uric acid.

Variation in Purin Excretion in Gout.—

IN CHRONIC GOUT.—(1) *Endogenous purins*: excretion about equal to lowest average of health, i.e., a constant diminution.

(2) *Exogenous purins*: a purin-rich meal to a gouty man causes an increased secretion, but smaller and slower than in health. (Thus retention occurs in purins from both sources.)

IN ACUTE GOUT.—Before and after attack, purin excretion is low. Shortly after attack commences, excretion rapidly rises above normal limits, then falls again.

Increase of Uric Acid in Blood in Gout.—In health, blood contains no free purins, and total is about 0.002 gm. per 100 c.c. In gout: (1) Free purin (uric acid) is present, 0.003 gm. per 100 c.c.; (2) Total amount is about 0.01 gm. per 100 c.c. Thus the uric acid in the blood is definitely increased. Theoretically, this increase may result from:—

1. *Increased production.*—Against this: increased production, and increased amount in blood, occur in leukaemia and leucocytosis, and then are always accompanied by increased excretion.

2. *Diminished excretion by kidney, with normal production.*—Supported by low purin excretion in gout and deficient excretion after purin-rich meal. *Generally accepted cause.*

Note.—The liver can destroy purins, and takes some unknown part in production of gout.

Diminished Excretion by Kidney of Uric Acid in Gout.—Two main possibilities to account for cause: (1) A primary renal defect, i.e., gout is a renal disorder. Against this: large excretion in acute gout proves that kidneys are not inherently unable to eliminate uric acid. Gout is not a primary renal but a metabolic disturbance. (2) Uric acid in gout circulates in an abnormal form which kidneys cannot eliminate. A reasonable working hypothesis.

Gout—Chemical Pathology, *continued*.

The Form in which Purins Circulate in the Blood.—Two questions are involved:—

1. ARE THE PURINS COMBINED WITH PROTEIN?—No test for uncombined purins reveals them in normal blood. Minkowski suggested that purins in blood are normally combined with protein from which the kidney can separate and excrete them. Von Noorden further suggests that in gout this protein is deficient (or abnormal), hence kidney has to deal with uric acid uncombined or abnormally combined and with difficulty excreted. (This question deals with cause of retention of uric acid in gout.)
2. IN WHAT FORM IS THE URIC ACID?—Admittedly as a sodium salt. *Gudzent's Theory*: Uric acid circulates as biurate NaHU ; biurate exists in two forms: (a) Unstable, soluble 'lactam' form, contains group CO—NH— ; and (b) Stable, less soluble 'lactim' form, contains group —C(OH)=N— ; on changing from (a) to (b) blood becomes a supersaturated solution, and biurate is deposited. (This question deals with cause of deposition of urates.)

In leukaemia, etc., where also excess of urates occurs in blood, compensatory excretion does not allow time for the change in form, and hence no deposition follows.

Relation of Gouty Paroxysms to Deposition of Biurates.—

Various questions arise:—

Does a paroxysm correspond with deposition of biurates?—

Frequently illustrated by increase in size of visible deposits.

How does deposition excite a paroxysm?—Generally ascribed to inflammation resulting from the irritation caused by rapid deposition.

Selection of certain joints.—Ascribed to: (1) Frequent injury: in great toe, inflammation of joint is a common occurrence; forms focus for deposit. (2) High percentage of sodium salts, decreasing solubility of urates; is maximum around joints. (3) Low temperature, locally decreasing solubility.

Why are the urates suddenly deposited in gout?—Deposition of crystals from any supersaturated solution *in vitro* depends on various factors, many at present obscure, e.g., shaking, temperature, presence of a nucleus, increase of certain ions (in this case sodium). Such deposition *in vitro* may occur either suddenly or gradually in different conditions. A minute change may result in a sudden and complete deposition. Exact factors in gout unknown.

Rise of purin excretion during acute attack also unexplained.

Notes.—

ABNORMALITY OR DEFICIENCY OF FERMENTS (*see above*).—

Has been advanced as cause of excess or abnormal form of purins in gouty blood.

Action of these ferments little known, but undoubtedly important.

CHRONIC INTERSTITIAL NEPHRITIS AND GOUT.—Often coexist. In chronic nephritis, deposits of urates occur without paroxysms: excretion of urates is diminished and free urates often detectable in blood; deposits probably occur *slowly*. Chronic nephritis very common in chronic gout. Many essential questions in gout are yet unsolved, e.g., importance of ferments, influence of xanthin and other purins besides uric acid.

Summary of Chemical Pathology of Gout.

1. The uric acid and purins circulate in the blood in abnormal form.
2. The kidney is unable to separate and eliminate uric acid from this combination.
3. Uric acid salts consequently accumulate in the blood.
4. These uric acid salts alter from a soluble to a less soluble state, and the blood becomes supersaturated.
5. Sudden deposition of urates occurs from this supersaturated solution.
6. Inflammation is excited mechanically in the tissues affected, and a gouty paroxysm occurs.
7. After the deposition of urates and the resulting paroxysm, the blood is temporarily freed of the excess; the patient often feels unusually well. The unknown cause is still present, and the accumulation of urates in the blood commences again.

CHAPTER LXVI.

DIABETES MELLITUS.

A condition due to deficiency of the internal secretion of the pancreas producing disturbance in metabolism of carbohydrates, and also of fats and protein, and characterized pathologically by hyperglycæmia and by long-continued glycosuria, and clinically by thirst, polyuria, emaciation, and tendency to coma.

Etiology.—

AGE.—All ages from birth: commonest thirty to sixty years. In youth, rapid and severe.

SEX.—About 3 males to 2 females.

RACE.—Hebrews and Eastern races very liable.

HEREDITY.—Not infrequent. Often mild, but in other instances severity increases in successive generations. Probably Mendelian recessive character.

PREDISPOSING CAUSES.—Common in obesity. Excessive ingestion of carbohydrates not proved as cause, but often present. Nervous strain often precedes symptoms (increase of adrenalin suggested). Sepsis increases glycosuria.

For metabolism of carbohydrates, normal and diabetic, for theories of diabetes, and for acidosis, see CARBOHYDRATE METABOLISM, Chapter LXVII, p. 348.

Diabetes Mellitus, *continued*.

Morbid Anatomy.—(Changes are mainly those of complications, except in pancreas.)

PANCREAS.—Little macroscopic change. *Histology*: Diffuse fibrosis invading acini; *islands of Langerhans degenerate early*; distribution irregular; interlobular fibrosis slight.

LUNGS.—Tuberculosis or pneumonia common. Rarely, gangrene.

KIDNEYS.—Large markedly brick-red kidneys occasionally occur ('diabetic kidney'). Common change is hyaline degeneration in descending loop of Henle. Chronic nephritis frequent.

LIVER.—Usually no change. Glycogen absent.

BLOOD.—Rarely lipæmia, if death in coma.

ARTERIOSCLEROSIS.—Common. Occasionally myocarditis.

Symptoms.—

ONSET.—Gradual. Rarely sudden symptoms after shock.

INITIAL COMPLAINTS.—Commonly: (1) Thirst; (2) Polyuria; (3) Emaciation and weakness; (4) Boils, ulcers, and carbuncles.

Occasionally: (5) Gangrene; (6) Pruritus; (7) Cataract.

CHARACTERISTIC FEATURES.—

THIRST } Fluid needed for excretion of sugar, and for
POLYURIA } hyperglycæmia.

APPETITE usually increased. Digestion good.

EMACIATION AND WEAKNESS.—Usually rapid and progressive; extreme in youth.

TONGUE.—Large, dry, and red ('raw beef').

SKIN.—Dry. Sweats occur with phthisis.

Temperature low. Pulse rapid. Constipation common.

Urine.—Presence of sugar is characteristic but not essential. *Chief characters*: (1) Amount: from 3 to 4 or more litres (100 to 150 ounces or more). (2) Specific gravity: usually 1025 to 1045. (3) Colour: very pale. (4) Glucose present: mild cases, 1 to 2 per cent; severe, over 5 per cent. Daily excretion very variable: often 100 to 500 grammes (3 to 15 ounces), but may exceed this. (5) Albumin absent in mild forms: trace common in chronic and severe forms, and with chronic nephritis. *Other features*: Increased excretion of total N, uric acid, urea, phosphates.

Blood-sugar.—Raised (See pp. 351 and 353).

Blood.—Red cells variable: secondary anæmia or polycythæmia. Rarely lipæmia.

Complications.—Any of these complications may be the initial feature to attract attention.

1. **DIABETIC COMA.**—See p. 344.

2. **HYPOGLYCÆMIA.**—See p. 347.

3. **PULMONARY DISEASE.**—Cause of death in 40 per cent. (i) Tuberculous caseating bronchopneumonia: rapid. (ii) Acute pneumonia. Rarely: (iii) Gangrene.

4. **SKIN, LOCAL INFECTIONS, AND SEPSIS.**—Very common : attributed to sugar in blood. (i) Boils and ulcers. (ii) Carbuncles. (iii) Pruritus, balanitis. (iv) Diabetic gangrene : rare under 50 years ; begins at toes ; usually moist ; blue discoloration ; extends. Arteriosclerosis present in area. Glycosuria often slight.

SKIN MAY BE STAINED with lipochromes from vegetables, producing pseudo-jaundice (carotinæmia).

5. **PERIPHERAL NEURITIS.**—Tinglings common. Absence of knee-jerks first sign. Perforating ulcers not uncommon. 'Diabetic tabes' : knee-jerks absent, steppage gait, pains in legs. Sciatica, lumbago, and various neuralgias common in elderly persons. Posterior columns of cord may be affected.

6. **EYE.**—(i) Cataract : in young or old ; rapid, often bilateral, soft type. (ii) Diabetic retinitis. Changes are (a) glistening patches, often near macula, but not in star shape as in albuminuria, (b) small hæmorrhages. The two changes occur separately or together. Distinction from albuminuric retinitis rarely definite. (iii) Rare : Amblyopia, blindness, central scotoma, from retrobulbar neuritis. Thrombosis of central vein. Optic atrophy. Sudden amaurosis. Lipæmic vessels.

7. **RENAL.**—Chronic nephritis not uncommon in chronic cases. Albuminuria otherwise uncommon, except in severe and chronic cases. Occasionally : cystitis, pneumaturia (yeast in bladder). When acute nephritis occurs, sugar in urine temporarily diminishes or disappears, from impermeability of diseased kidney.

8. **SEXUAL FUNCTIONS.**—Impotence in late stages if untreated. Pregnancy can take place.

OTHER COMPLICATIONS.—Gastritis, diarrhœa, myocarditis, arteriosclerosis.

Prognosis.—*Mild* types : good. *Severe* types : with marked symptoms and high blood-sugar, depends greatly on correct treatment and observance by patient : may continue many years.

INSULIN.—No ill-effects from prolonged use. Diabetes may be controlled for many years.

COMPLICATIONS.—Tuberculosis : always serious. Sepsis and simple coryza disturb insulin and predispose to coma. *Arteriosclerosis* : serious accessory feature.

YOUNG SUBJECTS.—Progressive deterioration usual (see p. 343).

ELDERLY SUBJECTS.—Less serious. Main risks are complications—e.g., sepsis, gangrene, retinitis, cataract, neuralgias.

FATAL TERMINATIONS.—In youth, coma. In older group : coma, myocarditis, sepsis, gangrene, nephritis, bronchitis.

Diagnosis.—Combination of glycosuria with symptoms of diabetes is sufficient for immediate diagnosis. Sugar in urine must be glucose. Blood-sugar estimations necessary for distinction from renal and other forms of glycosuria (see p. 345).

Diabetes Mellitus—Diagnosis, continued.

Fehling's solution also reduced by lactose, pentose, homogentisic acid (alkaptonuria), and partly by creatinin, uric acid, glycuronic acid. Benedict's solution is not reduced by creatinin or uric acid. *Deception* occasionally by addition of cane-sugar or lactose (no fermentation with yeast); rarely by glucose.

TREATMENT OF DIABETES.

Aim of treatment is: (1) To adjust for the needs of the individual subject an adequate and not unappetizing diet with or without the use of insulin, such that (2) the blood-sugar is within normal limits, and (3) the urine is free from sugar, and (4) free from ketones. For such standardization a correct balance must be obtained between the diet and the insulin injections. Blood-sugar and urine must be examined at intervals.

Observation must be maintained subsequently, especially on first return to ordinary activities, as adjustments may be necessary, particularly in dosage of insulin.

The general principles of standardization will be considered for an adult of medium severity with ordinary insulin. Subsequently the features of mild cases, certain special conditions, children, and zinc protein insulin.

General Measures.—Treat all sources of infection and sepsis—e.g., boils, carious teeth. Bed at onset. Regulate bowels. Fluids not to be stinted.

Basal Diet.—Calculated for individual as follows:—

TOTAL CALORIES.—Is starting point for standardization of diet.

1. *Measure body-weight in kilos* (1 kilo = 2.2 lb.). *Note:* If markedly under- or over-weight, accept previous normal weight (if known), or preferably obtain 'correct' body-weight from a body-weight and body-length table.
2. *Allow 25 calories per kilo.* Number of calories required is thus ascertained. *Note:* Active life may need 30 calories or heavy work 35 calories or more per kilo. It is often convenient initially to standardize against insulin at 25 calories, and subsequently to increase the diet as necessary and add required insulin.

CARBOHYDRATE, PROTEIN, AND FAT.—The required calories are now apportioned to these three categories: (1) *Protein:* allow 1 gm. per kilo. (2) *Carbohydrates:* allowance formerly about 1 gm. per kilo, balance of calories being provided by fat; ketosis frequently occurred. Better results now obtained from allowing carbohydrates 2 gm. (or more) per kilo, fat not exceeding 80 to 100 gm.

EXAMPLE.—

Weight 10 stone = 64 kilos. *Calories* = 1600.

1. Carbohydrate, $64 \times 2\frac{1}{2} = 144$ gm. = 590 calories.
2. Protein, $64 \times 1 = 64$ gm. = 260 "
3. Fat, 84 gm. = 760 "

Carbohydrates mainly given at meals following insulin injections.

Insulin.—

INDICATIONS FOR INSULIN.—For all except mild cases. (1) Ketosis, severe glycosuria, high blood-sugar; (2) Rapid wasting; (3) Presence of complications; (4) Glycosuria before basal diet reached; (5) Children.

METHOD OF STANDARDIZATION.—(1) Place on initial or basal diet; commence insulin injections, 5 (according to blood-sugar) units, 20 minutes before breakfast and supper. (2) Gradually increase insulin as necessary: first add 2 to 5 units in morning, then 2 to 5 units in evening, continue similar rises at intervals of 2 to 3 days. Test urine regularly (morning and evening specimens), and blood-sugar at intervals, preferably before insulin and before midday meal. Finally urine must be sugar-free and blood-sugar (especially fasting) within normal limits.

Note: Number of grammes carbohydrate metabolized by 1 unit of insulin varies and cannot be fixed: is often about 4 gm.

SUBSEQUENT LIFE (*see also* COMPLICATIONS, p. 338, and SPECIAL CONDITIONS, p. 343).—Needs regular observation on the urine: insulin requirements may fall or rise without obvious cause, often falling with strict adherence to diet. Patient should learn to test urine and inject insulin, and be instructed as to hypoglycæmia. *Note also:*—

1. **BODY WEIGHT.**—Preferably kept slightly under normal. Rapid gain often follows insulin treatment: if excessive, adjust diet.

2. **INTERCURRENT DISEASES.**—(a) Coryza, influenza—striking effect, often needs great rise in insulin, may be permanent; (b) Pneumonia, etc.—normal diet for the disease must be given and insulin temporarily adjusted.

COMPLICATIONS.—(1) Pain on injection: blunt needle or psychical. (2) Local swelling: rare, may be allergic. (3) Hypoglycæmia; (4) Œdema ('insulin œdema'): may develop with rapid fall in blood-sugar, due to lowered osmotic pressure; usually clears in 2 or 3 weeks.

There is no absolute contra-indication to insulin.

Note: In certain diabetics it is impossible to keep the blood-sugar normal and urine free of sugar without the greater disadvantages of frequent hypoglycæmia.

Zinc Protamine Insulin.*—Ordinary insulin is a solution, easily absorbed, with a rapid short action. *Protamine insulin* ('insulin retard') is a combination of insulin with protamine, obtained from sperm of *Salmo iridius*; it is given in suspension, has a low solubility in serum, and consequently slower absorption and more prolonged action, and fewer injections are needed. Zinc is plentiful in pancreas, and present in all insulin; addition to protamine insulin renders it more stable: zinc protamine insulin will keep for a few weeks.

Zinc protamine insulin commences effect in about 3 hours, maximum in about 8 hours, and total duration about 20 hours.

* Knowledge of these insulins is advancing rapidly, and new preparations are being introduced.

Diabetes Mellitus—Treatment, *continued*.

SPECIAL EFFECTS.—

1. Slow absorption produces less rapid fluctuations in blood-sugar. Larger carbohydrate diet can be taken.
2. Slow action does not control rise of blood-sugar and glycosuria after carbohydrate meal. With one morning dose, no persistent attempt to be made to control glycosuria after breakfast.
3. *Hypoglycæmia*. Less common, but severer and more prolonged and less rapidly checked by carbohydrate (as insulin action continues). Tendency to follow exercise (give preliminary carbohydrate).
4. Unknown if zinc has deleterious effects.
5. *Ketonuria*. Well controlled.

METHODS OF ADMINISTRATION.—

If given at night: Controls blood-sugar during night. Modified dose of ordinary insulin may be given in morning.

If given in morning only. Does not always control morning glycosuria. With this exception, many subjects are satisfactorily standardized with one injection.

Combination with ordinary insulin. Can be given in same syringe, but must not be mixed. Given before breakfast to combine effects: *never at night*. Results very good.

DIET.—Carbohydrates to be divided about equally for breakfast, lunch, tea, dinner, and at bedtime.

STANDARDIZATION: CHANGE FROM ORDINARY INSULIN.

—To be carried out slowly. Zinc protamine insulin acts slowly, and effect somewhat deceptive when commencing: risk of severe hypoglycæmia if dose increased too rapidly. Units necessary about same as ordinary insulin.

Insulin Sensitive and Insulin Resistant Diabetes.—It is now recognized that two groups of diabetes exist which differ in reaction to insulin. Knowledge is incomplete, but advancing. Main differences are as follows (provisional):—

1. **INSULIN-SENSITIVE SUBJECTS.**—Younger ages. Onset usually acute. Characteristic diabetic symptoms marked. Blood-sugar rapidly sensitive to injections of insulin. Large increase of carbohydrate in the diet may need only a slight increase of insulin. This group is attributed to deficiency of insulin.
2. **INSULIN-RESISTANT SUBJECTS.**—Elderly subjects; usually but not always obese. Onset insidious. Characteristic diabetic symptoms slight. Slight increase of carbohydrate in diet may need large increase in insulin. Blood-plasma on injection into insulin-sensitive subjects inhibits the action of insulin; this action is identical with that of anterior pituitary extracts. This group is attributed to presence in the blood of some substance inhibitory to action of insulin, probably anterior pituitary secretion.

SPECIAL CONDITIONS.

Mild Cases.—Cases with: no complications; no ketosis; moderate glycosuria and rise in blood-sugar. Some may be treated on diet alone, as follows:—

STARVATION.—For twenty-four to forty-eight hours, to render urine sugar-free. Give bovril, weak tea, and lemonade; no sugar or milk; fluids not stinted.

PROGRESS.—Add articles daily until basal diet is reached in ten to twelve days. If sugar-free and blood-sugar within normal limits, can continue on this diet.

Elderly Subjects.—May remain symptomless and without advance for many years: glycosuria often discovered during routine examination. Severe treatment is unnecessary; the following is sufficient: (1) General restriction of carbohydrates, e.g., bread, potatoes, pastry; (2) Saccharine for sugar. Slight glycosuria is preferable to frequent hypoglycæmia.

BLOOD-SUGAR.—Often high; renal threshold for sugar frequently raised (may be over 0.25 per cent).

KETOSIS.—Needs more systematized treatment, but great restrictions inadvisable.

Children.—Insulin invariably needed: commence immediately on diagnosis. Prognosis without insulin about 2 years; with insulin good, but constant attention necessary.

SPECIAL DIFFICULTIES.—Numerous:—

1. **ADDITION TO BASAL REQUIREMENTS.** . (a) For growth, 40 per cent; (b) For great activity of youth, about 20 per cent (much higher calories are normally used between 12 and 16 years). Total requirements (approximate): at 5 years, 1500 calories; at 10 years, 2000 calories; at 15 years, 3000 calories. Basal requirements for various ages, height, and weight have been calculated exactly by League of Nations Committee.

2. **PROTEIN.**—Give 2 gm. per kilo body weight. **FAT** moderate.

3. **GROWTH.**—Involves frequent changes in diet and insulin.

4. **BLOOD-SUGAR.**—Alters rapidly, especially under insulin, hence tendency to hypoglycæmia; 3 or 4 injections daily may be necessary.

5. **KETOSIS** and **COMA** common.

6. **INFECTIOUS FEVERS, ETC.**—Frequently disturb standardization.

7. **DIFFICULTY OF CONTROL.**—Tendency to secret consumption of sweets, objections to insulin, etc.

METHOD.—Standardize initially at moderate figure, and then increase to individual requirements. Work and games allowed. Zinc protamine insulin may be used.

Pregnancy.—Rare in severe grades: abortion usual. In previous diabetics, more insulin necessary; increase may be permanent; pregnancy in general inadvisable. Induction not necessary

Diabetes Mellitus—Special Conditions, continued.

unless there is ketosis, rapid advance, or difficulty in treatment. Insulin does not harm foetus. In puerperium tendency to hypoglycæmia.

Surgical Operations.—Not contra-indicated. In preparation, no starvation or omission of insulin. One hour before operation; glucose 2 oz. by mouth, insulin 30 units. On recovery: milk diet and insulin six-hourly; glucose if ketosis.

ANÆSTHETIC.—In order of preference: (1) Local or spinal; (2) Gas and oxygen; (3) Ether. Never chloroform.

DIABETIC COMA.

Invariably associated with acidosis and presence of ketones in the urine; mode of production of coma unknown. May develop both in severe cases and also in relatively mild forms as result of infections, careless variations of diet and insulin, aided by constipation.

Prodromal Signs.—(1) Headache or restlessness; (2) Epigastric discomfort; (3) Nausea and anorexia. *Urine*: ketosis (ferric chloride test positive). Also numerous casts. *Blood-sugar*: high, usually 0.4, always above 0.2.

Features of the Coma.—Unconsciousness partial or complete. 'Air-hunger' (slow deep respirations), pulse rapid, temperature subnormal, leucocytosis. *Flaccidity*, viz., blood-pressure low, *eyeballs soft* (Krause's sign); knee-jerks and deep reflexes absent, *plantar response flexor*. Odour of acetone. In some cases, onset of coma rapid without warning: severe collapse, lividity, shallow breathing. Alkali reserve low.

Diagnosis.—From other causes of coma (*see* p. 315), especially from: (1) Hypoglycæmia; (2) Meningitis, especially in children; (3) Cerebral hæmorrhage; (4) Uræmia; (5) Morphia and narcotic drugs.

IN HYPOGLYCÆMIC COMA.—(a) Spasticity, viz.—eyeballs firm, plantar response extensor, absence of knee-jerks (if found) is due to rigidity; (b) Blood-sugar low: urine, no ketones, no sugar (may be in bladder from previous excretion).

Treatment.—Test urine for sugar and ketosis; blood for blood-sugar. Cases vary so greatly that a definite routine is impossible. Influenced by previous record of diabetes. Frequent blood-sugar estimations of obvious assistance. Risk of hypoglycæmia from overdosage with insulin important.

GENERAL TREATMENT.—Keep warm. Enema. Stomach wash if vomiting. Fluids freely. Cardiac stimulants if collapsed. No food.

INSULIN (ordinary).—Initial injection: 40 to 60 units subcutaneously. If coma profound, 60 to 80 units, also 50 units intravenously. Glucose: 2 oz. well diluted, by mouth or stomach-tube; if impracticable, inject intravenously 20 c.c. of 10 per cent solution.

CIRCULATORY FAILURE.—Serious. Often severe: pulse rapid, blood-pressure low. Interferes with subcutaneous absorption of insulin: inject intravenously. Also cardiac stimulants; strophanthin gr. $\frac{1}{100}$ intravenous; or intravenous hypertonic saline, 500 c.c., 2 per cent solution. Coma usually deep.

SUBSEQUENT PROGRESS.—Repeat insulin, 30 to 40 units, and glucose every three hours, until patient conscious or urine sugar-free. Control by blood-sugar estimations. If no improvement in 6 to 8 hours, increase to 40 or 60 units, every two hours. (No further insulin when urine is sugar-free without blood-sugar control).

CONSCIOUSNESS RECOVERED.—Insulin 10 to 15 units every 4 or 6 hours. Glucose in milk, half-pint 4-hourly, or better as skimmed milk. If coma tends to return, estimate blood-sugar to eliminate hypoglycæmia (see **HYPOGLYCÆMIA**, p. 347).

FURTHER TREATMENT.—In 48 hours, place on standard diet, but initially omit *fat*. Insulin dosage may be high for few days, but often falls rapidly. *Treat any septic focus.*

ANURIA.—With above, or renal failure. Serious feature. Interferes with observation of progress.

GLUCOSE ADMINISTRATION.—Advisability with insulin injections much disputed, now generally accepted. Glucose reduces risk of hypoglycæmia and aids reduction of ketosis. Coma is not directly due to hyperglycæmia.

ALKALIS.—Generally believed that alkalis do not assist.

HYPOGLYCÆMIA.—See p. 347.

VARIOUS OTHER CONDITIONS ASSOCIATED WITH GLYCOSURIA.

Glycosuria may occur over many years (or a lifetime) without symptoms of diabetes: sometimes known as 'diabetes innocens'. Blood-sugar curves are usually not of diabetic type. Diagnosis must be made with great care. Prognosis also at present guarded, as state may drift into true diabetes or hypoglycæmia develop. No glycosuria can be safely neglected permanently in which blood-sugar exceeds normal.

Certain glycosurias are not directly due to pancreatic deficiency, but to interference by thyroid secretion, etc.: such are originally non-pancreatic, but may produce diabetic symptoms.

1. Normal Persons with Excessive Ingestion of Carbohydrates.
—Glycosuria only occurs in experimental conditions.

2. 'Renal Glycosuria.'—Not uncommon. 'Renal threshold' is low, and transient glycosuria occurs after a meal.

CHARACTERISTICS.—

a. Persistent or intermittent glycosuria relatively independent of diet. No diabetic symptoms. Often discovered accidentally.

b. Hereditary factor not uncommon.

Conditions associated with Glycosuria—'Renal Glycosuria', *continued*.

- c. Amount of sugar in urine in 24 hours is usually small.
- d. Blood-sugar curve below normal limits. Fasting level low—e.g., 0.06 per cent. Maximum ingestion level about 0.14 per cent, glycosuria occurring at this point. Occasionally threshold is higher and glycosuria intermittent.
- e. Insulin dangerous. Restriction of carbohydrates often does not prevent glycosuria, may produce abnormal blood-sugar curves: strict diet may cause ketosis, and is contra-indicated.
- f. Condition as above often harmless: has been watched for years. Usually some debility.
- g. Hypoglycæmia is akin. Symptoms may occur.
- h. True diabetes may develop. Renal glycosuria, therefore, needs regular observation and guarded prognosis until long watched. Occasionally diabetic and renal blood-sugar curves appear to be combined, or conditions intermit with each other.

3. '**Lag Curves.**'—In persons exhibiting glycosuria (without diabetic symptoms) blood-sugar curve occasionally gives rapid ascent to 0.20 or 0.25 in $\frac{1}{2}$ hour, falling rapidly in $1\frac{1}{2}$ to 2 hours to normal fasting level, or definitely below to hypoglycæmia. Described by MacLean as 'lag curve', attributed to failure of storage metabolism to act until blood-sugar has passed 'renal threshold': possibly associated with adrenal defect. Others ascribe it to rapid emptying of stomach, as not uncommon with duodenal ulcer. Neither explanation is satisfactory. Many individuals have been glycosurics of this type for years without harm, but true diabetes may develop and constant observation is advisable. Often controllable by restricting sugar while permitting starch. May be intermittent, occurring when subject is debilitated.

Note.—Relation of renal glycosuria and 'lag curves' to true diabetes and hypoglycæmia is uncertain. Blood-sugar curves with short sharp rise and fall to hypoglycæmia may occur after gastric operations—e.g., gastro-enterostomy—without glycosuria.

4. **Alimentary Glycosuria.**—A term of former days before the knowledge of blood-sugar and the 'renal threshold'. Possibly applicable to obese subjects with transient glycosuria after heavy meals, but many are, correctly, mild and insulin-resistant diabetes.

5. **Hyperthyroidism.**—May be result of (i) exophthalmic goitre, (ii) administration of thyroid in myxœdema, obesity, etc.

Note:—

- a. Hyperthyroidism produces hyperglycæmia. Blood-sugar curve may resemble severe diabetes.
- b. In exophthalmic goitre there is often a very high 'renal threshold', and there may be marked hyperglycæmia without glycosuria.

- c. With treatment of hyperthyroidism, blood-sugar may become normal.
- d. Thyroid hyperglycæmia may develop into true and permanent diabetes.

6. Dyspituitarism.—The disturbances of carbohydrate metabolism are complex, and cannot be apportioned satisfactorily to hyper- and hypopituitarism. Glycosuria and diabetes may apparently occur in any group of dyspituitarism.

7. Hæmochromatosis.—Pancreas is destroyed by deposits of iron. In other conditions, lipoids, etc., are deposited. True diabetes results.

'Phloridzin Glycosuria.'—Produced experimentally by administration of phloridzin (a glucoside). Hypoglycæmia results. Excretion of sugar is enormous. It continues on carbohydrate-free diet and when liver is empty of glycogen; hence sugar is produced from fat or protein. Mode of action unknown: possibly kidney can split off and excrete glucose from phloridzin, which then recombines with blood-sugar, forming a cycle.

HYPOGLYCÆMIA.

The occurrence of hypoglycæmia and resulting symptoms is of recent study. The condition is also described as 'hyperinsulinism'.

Causes.—Hypoglycæmia is recorded in following conditions:—

1. EXCESS OF INSULIN.—

- a. 'INSULIN HYPOGLYCÆMIA.'—Therapeutic injections.
- b. IDIOPATHIC HYPOGLYCÆMIA.—Heredity distinct. Often, not always, with renal diabetes.
- c. PANCREATIC LESIONS.—Adenoma of islands of Langerhans. Rare. Attacks commencing mildly: with progress, become severe and frequent.

2. DIMINISHED SECRETIONS ANTAGONISTIC TO INSULIN.—

- a. ADRENALS.—Addison's disease.
- b. PITUITARY.—Anterior-lobe tumours.
- c. THYROID.—In myxœdema.

3. LOSS OF DEXTROSE.—'Renal diabetes.'

Note.—Lowered renal threshold may be result of hypoglycæmia.

4. DESTRUCTION OF LIVER (interference with storage).—

Primary carcinoma; any cause of acute necrosis.

5. EXCESSIVE PHYSICAL EXHAUSTION.

Note.—Starvation does not cause hypoglycæmia in normal persons.

Blood-sugar.—Below 0.80 per cent is hypoglycæmia, but level of symptoms very variable. Onset about 0.07 (children lower), severe at 0.05, death at 0.025 (approximate).

BLOOD-SUGAR CURVES.—These vary: may be high rise and rapid fall to low level; diabetic curves are recorded. In diabetes, symptoms may develop at high levels—e.g., 0.20.

Hypoglycæmia, continued.**Symptoms.—**

Acute forms especially in insulin hypoglycæmia: usually about 3 hours after injection; may persist several hours. Order of onset varies:—

- a. Feeling of inertia; faintness or giddiness; hunger.
- b. Nervous sensations; anxiety; hysteria; tremors.
- c. Hot and sweating or cold and pale.

Pulse may be rapid. Headache. Vomiting rare.

Progress, in absence of treatment: emotional disturbances increase, mental confusion; faintness, collapse. Difficulty in articulation, tremors, and diplopia may occur (suggesting alcoholism): also inco-ordination. Twitchings and, in children, convulsions. Various complex nervous manifestations. Finally: unconsciousness, coma. Onset of symptoms, after first occurrence, readily recognized by patient.

Mild Types in chronic hypoglycæmia: exhaustion, headache; but may be acute exacerbations, with convulsions, etc.

Remote Manifestations.—Hypoglycæmia (and resulting ketosis) may be concerned with numerous conditions, e.g., forms of cyclical vomiting, migraine, vomiting of pregnancy, night terrors, attacks of exhaustion, vertigo, collapse, and convulsions.

Physical Signs.—See DIABETIC COMA, p. 344. Note that extensor plantar response distinguishes from diabetic but not from all other causes of coma.

Treatment.—Rest.

In milder degrees: Ingestion of sugar, e.g., four lumps of sugar, barley sugar, or 1 or 2 oz. of 50 per cent glucose: repeated in 15 minutes. Orange juice.

In severer degrees: (i) Inject adrenaline, 1 c.c. of 1-1000 solution; and (ii) Inject glucose, 20 per cent, 10 to 20 c.c. intravenously, also per rectum. Glucose, 1 to 2 oz. by mouth later.

Insulin dosage to be readjusted.

CHAPTER LXVII.

CARBOHYDRATE METABOLISM, NORMAL AND PATHOLOGICAL.

NORMAL CARBOHYDRATE METABOLISM.

In normal carbohydrate metabolism there are two principal stages: (1) Alteration of ingested carbohydrates into the form convenient for use; (2) Use of such prepared carbohydrate for the production of energy by the muscles.

The first stage is performed by ferments in the alimentary canal and liver. The second stage needs the assistance of pancreatic secretion (insulin).

Besides the pancreas, certain other ductless glands and organs have subsidiary though important influences. Storage mechanism also exists for surplus carbohydrates not immediately required.

Influence of Ductless Glands and other Tissues.—Four ductless glands influence the amount of sugar in the blood, viz.: (a) Diminish: pancreas. (b) Increase: adrenals, pituitary, and thyroid.

PANCREAS.—Minkowski and Mering discovered relationship to diabetes and thus to carbohydrate metabolism. Removal of not less than three-fifths of pancreas produces experimental diabetes. Internal secretion (insulin) is produced by cells of islands of Langerhans; two types of cells present, known as α and β ; secretion probably only from β cells. External pancreatic secretion has no relation to diabetes.

INSULIN.—The internal secretion of the pancreas is essential for the oxidation of sugar by the tissues. Deficiency is the ordinary cause of diabetes. The brilliant researches leading to its discovery were carried out by F. G. Banting and C. H. Best of Toronto and their co-workers. Banting and Best adopted the following method: It was known that if pancreatic ducts are ligatured, cells secreting digestive enzymes degenerate in a few weeks, while islands of Langerhans are little affected; extracts of such glands were prepared, and on injection into depancreatized dogs were found to diminish sugar in blood and lengthen life.

Standardization.—Insulin preparations are standardized by action on normal rabbits. Three units is the amount of insulin which on subcutaneous injection into a rabbit weighing 2 kilo from which food has been withheld for 16 to 24 hours lowers percentage of blood-sugar within 3 hours to 0.045 (convulsions occur at this point).

Note.—Ten units is approximately equivalent dose for human beings.

ADRENAL GLANDS.—Action of adrenaline:—

1. Hyperglycæmia and glycosuria follow injection, even in starving animals.
2. Action specially marked in diabetes and depancreatized animals.
3. In Addison's disease, where internal secretion is deficient, hypoglycæmia and increased carbohydrate tolerance are present.

MODE OF ACTION.—Increases glycogenolysis from liver and other stores, and thus raises blood-sugar.

PITUITARY GLAND (HYPOPHYSIS).—

ACTION OF EXTRACT OF POSTERIOR LOBE ON INJECTION.—

Directly antagonizes action of insulin and thus raises blood-sugar. An injection too small to cause any appreciable rise in blood-sugar may yet be sufficient to prevent the action of an injection of insulin. Also antagonizes action of adrenaline.

NOTE.—(a) With hypersecretion of posterior lobe, hyperglycæmia and glycosuria occur: as in early acromegaly and

Carbohydrate Metabolism—Influence of Ductless Glands, continued.

certain tumours of the gland. (b) With hyposecretion, hypoglycæmia and increased carbohydrate tolerance occur: as in late acromegaly, Fröhlich's disease, and removal of gland. In fractures of skull and operations disturbing gland, hyperglycæmia is not uncommon.

THYROID GLAND.—Note: (a) With excessive secretion, hyperglycæmia and glycosuria result; not uncommon in exophthalmic goitre. (b) In myxœdema, hypoglycæmia and high carbohydrate tolerance are present.

MODE OF ACTION.—Stimulates secretion of adrenalin.

NERVOUS SYSTEM.—Claud Bernard's 'piqûre', puncture of floor of 4th ventricle, results in glycosuria. Action is through left splanchnic nerve to the adrenals, stimulating secretion of adrenalin. Glycosuria ceases when liver is emptied of glycogen. Cerebral tumours, fractures, etc., may produce glycosuria also from action on pituitary gland.

Carbohydrates concerned in Metabolism.—

1. **MONOSACCHARIDES.**— $C_6H_{12}O_6$: (i) Dextrose (glucose, grape-sugar); (ii) Lævulose (fruit-sugar); (iii) Galactose; (iv) Mannose.
2. **DISACCHARIDES.**— $C_{12}H_{22}O_{11}$: (i) Saccharose (sucrose, cane-sugar); (ii) Lactose (milk-sugar); (iii) Maltose.
3. **POLYSACCHARIDES.**— $(C_6H_{10}O_5)_n$: Starch, cellulose, glycogen, dextrin.

REACTIONS.—Fermentations with yeast: monosaccharides. Fehling's and Benedict's solutions reduced by: monosaccharides, lactose, and maltose.

Normal Process of Carbohydrate Metabolism.—

IN ALIMENTARY CANAL.—Action on ingested carbohydrates: (1) *Starch* converted finally into maltose and dextrin by diastatic ferments of saliva, pancreatic, and intestinal juices; (2) Maltose and dextrin (ingested or from previous stage) converted into *dextrose* by ferments in intestinal mucous membrane; (3) Cane-sugar into dextrose and lævulose; (4) Lactose into dextrose and (possibly) galactose. All these carbohydrates thus become *monosaccharides, are absorbed, and pass into the liver.*

IN LIVER.—Processes are:—

1. Monosaccharides arriving from the alimentary canal are passed into the circulation in the form of dextrose. *Dextrose is sole carbohydrate leaving liver.*
2. When concentration of dextrose in the blood reaches a certain maximum point, excess is converted into glycogen and stored by the liver (and also by muscles).
3. Glycogen thus stored is converted into dextrose and passed into the blood as required by the tissues, thus preventing blood-sugar falling below a certain minimum point.

IN THE MUSCLES.—Processes are:—

1. Final combustion of dextrose with assistance of insulin, in production of energy—the *essential fate of carbohydrates.*
2. Storage of excess as glycogen.

Storage of excess carbohydrates as glycogen thus occurs in (1) liver and (2) muscles. Total, about 300 gm.

NOTES:—

SOURCES WHENCE LIVER CAN PRODUCE DEXTROSE.—

1. *Carbohydrates*.—Ingested.
2. *Proteins*.—From diet and body tissues. May be negligible in normal persons on normal diet. Occurs in starvation. Proof in severe diabetes: hyperglycæmia and glycosuria (a) continue on carbohydrate-free diet, (b) increase with amount of protein in diet.
3. *Fat*.—Not in normal persons on normal diet. (See FAT METABOLISM, pp. 354, 355.)

SUPPLY OF CARBOHYDRATES DEFICIENT, or less than demands of muscles.—Blood-sugar maintained at necessary level at first from glycogen stores and later from protein and fat.

SUPPLY OF CARBOHYDRATES EXCESSIVE.—(a) *Temporary and moderate*: excess stored as glycogen. (b) *Persistent and moderate*: excess converted into and deposited as fat—i.e., obesity results; blood-sugar normal.

CARBOHYDRATE TOLERANCE. 'ASSIMILATION LIMIT'.—

Method of Estimation.—Dissolve 100 or more grammes of glucose in 250 c.c. water and give in morning on empty stomach.

Normal Assimilation Limits (single dose on an empty stomach).—Glucose, cane-sugar: 150 to 200 gm. Lactose: 120 gm. or less. These are lower limits; in normal persons it is difficult to produce glycosuria with a single dose of carbohydrates.

Starch never causes glycosuria in normal persons, however great the amount, owing to slow absorption and digestion.

In obesity, glycosuria after ingestion of carbohydrate occurs more readily: usually ascribed to glycogen and fat deposits being overfull.

LÆVULOSE.—Metabolism differs from other sugars, and is carried further in the liver. Does not pass from the liver into the blood as carbohydrate, and consequently does not raise blood-sugar except when liver is diseased.

Action of Kidneys. 'Renal Threshold.'—Kidneys are not directly concerned in normal carbohydrate metabolism. Glycosuria occurs when concentration of blood-sugar reaches a certain level. This 'renal threshold' is normally about 0.17 per cent. In diabetes, kidneys become *less permeable to sugar* (Graham), and 'renal threshold' may rise to 0.20 or even 0.30 per cent. May also rise in nephritis.

Circulation of Sugar in the Blood.—The circulation merely transports carbohydrates; no metabolism occurs in the blood. Phenomena of blood-sugar may be considered under two forms:—

1. **FASTING BLOOD-SUGAR**.—Amount 'on an empty stomach' varies in different persons, but is normally between 0.08 and 0.12 gm. per cent. In a given person amount remains constant

Carbohydrate Metabolism—Circulation of Sugar in Blood, *continued*.

except after food, even with muscular exertion unless extreme; demands of muscles for sugar are conveyed to, and normally supplied from, the glycogen stores.

2. **INGESTION BLOOD-SUGAR.**—After a meal containing carbohydrates, blood-sugar increases and rises to a maximum, normally between 0.16 and 0.18 per cent—viz., near normal 'renal threshold'. At this point, just below where glycosuria would occur, storage processes (as glycogen) come into action and reduce blood-sugar to resting level even while absorption of carbohydrates is continuing.

NORMAL BLOOD-SUGAR CURVE AFTER A MEAL CONTAINING CARBOHYDRATES.—Tested in adults by ingestion on empty stomach of 50 or 100 gm. glucose in 250 c.c. water. Blood-sugar commences to rise at once, reaches a maximum in 30 to 45 minutes, then falls rapidly to resting level in 1½ hours—or often slightly below, returning to resting level in 2 hours. With large amounts of carbohydrates, fall to resting level is delayed, but ingestion maximum is not increased.

Age Variations.—In children under 3 years, ingestion maximum usually does not exceed 0.13. In later decades, over 60 years, return to resting level is delayed.

Summary of Normal Carbohydrate Metabolism.—

1. *Carbohydrates ingested* are converted into monosaccharides by ferments in the intestinal juices or mucous membranes and are then absorbed.
2. *After a carbohydrate meal*, dextrose reaching the circulation raises the amount of blood-sugar.
3. When blood-sugar reaches about 0.17 per cent—i.e., near 'renal threshold'—storage processes become active. Dextrose is converted into glycogen, stored in liver and muscles, and blood-sugar falls to resting level of 0.09 to 0.11 per cent.
4. *The muscles* combust dextrose for production of energy, the essential fate of carbohydrates. End-products are CO_2 and H_2O .
5. As blood-sugar is thus consumed, it is replaced normally from glycogen stores, thus maintaining the resting level.
6. Internal secretions control the above processes. Pancreatic secretion (insulin) is necessary for combustion of dextrose by muscles. Adrenalin increases and hastens conversion of glycogen into dextrose. Secretion of posterior pituitary lobe antagonizes action of insulin. Thyroid secretion and irritation of floor of 4th ventricle stimulate secretion of adrenalin.
7. Blood acts purely as means of transport. Kidneys act as safety-valves when blood-sugar rises too high.
8. If ingestion of carbohydrates be constantly excessive, unused balance is converted into and stored as fat.

METABOLISM IN DIABETES.

Phenomena are considered as : (1) Relation of pancreatic disease to diabetes ; (2) Insulin ; (3) Blood-sugar ; (4) Acidosis and ketosis ; (5) Metabolism in the liver, muscles, etc. (*See also* INSULIN SENSITIVE AND INSULIN RESISTANT DIABETES, p. 342.)

1. Relation of Pancreatic Disease to Diabetes (*see also* INFLUENCE OF DUCTLESS GLANDS, p. 349).—

MORBID ANATOMY OF PANCREAS IN DIABETES.—

- Chronic interacinar pancreatitis present in at least 70 per cent, with atrophy of the islands of Langerhans (Opie).
- Interstitial pancreatitis, carcinoma, lipomatosis present in a few cases, but cause glycosuria only when very advanced.
- No recognizable change in 10 to 15 per cent.

EXPERIMENTAL DIABETES.—Allen's experiments on partially depancreatized dogs (without insulin).

- On high carbohydrate and high fat diet : rapidly fatal diabetes.
- On very low carbohydrate and high fat and protein diet : less rapid but finally fatal diabetes.
- On a diet strictly limited in carbohydrates, fats, and protein : such diet—viz., just sufficient to supply needs of the body—gave longest life and least liability to diabetes.

HISTOLOGY.—On first two diets, Allen found that β cells of islands of Langerhans swell (hydrops), degenerate, and rupture. Ascribes this to overstrain of their functions by diets in excess of their powers.

PRINCIPAL CONCLUSIONS.—

- Excessive diet results in destruction of essential pancreatic cells and permanent advance of condition.
- Rest for pancreas is necessary.
- Carbohydrates, fats, and proteins must all be standardized.

Note.—Primary cause of degeneration of pancreas is unknown ; may continue to progress even on lowest possible diet.

2. Insulin.—

EFFECT OF INJECTIONS ON METABOLISM.—Studied in rabbits, depancreatized dogs, and human beings, normal and diabetic. Principal effects : (a) Blood-sugar falls ; (b) Ketonuria disappears ; (c) Respiratory quotient rises after injection for a short time only. Action maximum in one hour : lasts 4 to 5 hours.

MODE OF ACTION.—Insulin effects oxidation of dextrose in muscles. This cannot explain very rapid disappearance of blood-sugar after injections, as respiratory quotient does not rise sufficiently ; nor apparently is sugar stored. Possibly entire bodily metabolism is temporarily 'run' on sugar (Dale).

3. Blood-sugar.—Hyperglycæmia, an abnormal amount of blood-sugar, is the essential phenomenon of untreated diabetes and the cause of glycosuria.

BLOOD-SUGAR CURVE IN DIABETES.—Tested in adults by ingestion on empty stomach of 50 gm. glucose in 250 c.c. water.

Metabolism in Diabetes—Blood-Sugar, *continued*.

- a. Fasting level is above normal. In moderate cases it is below a normal 'renal threshold' (viz., 0.17 per cent); but in severe cases it is above, and may be 0.30 or higher.
- b. After carbohydrate ingestion, variations from normal curve are: (i) Rise persists longer, may be 2 or 3 hours; (ii) Reaches higher level, viz., 0.20 to 0.50 or more; (iii) *Fall is slower and does not return to resting level for several hours.*

The following points may be noted:—

- i. Occurrence of glycosuria depends on the blood-sugar rising above the 'renal threshold', temporarily or permanently.
- ii. In diabetes the 'renal threshold' tends to rise, and may be 0.20 or even 0.30 or higher. Thus definite hyperglycæmia, and even coma, may be present without glycosuria.
- iii. The amount of sugar in the urine does not run closely parallel to the degree of hyperglycæmia or to its variations, depending to some extent on other factors. For example, the *percentage* of sugar excreted usually rises with the volume of urine, and can be affected by administration of diuretics.

4. Acidosis and Ketosis.—See ACIDOSIS, p. 355.

5. Metabolism in the Liver, Muscles, Etc.—

METABOLISM IN THE LIVER.—Glycogen is absent from the liver in untreated diabetes. Overproduction of sugar by the liver in diabetes is proved by the excretion of 10 to 30 oz. daily in some cases. Advanced liver disease is not associated with glycosuria, though lævulosuria may occur.

METABOLISM IN THE MUSCLES.—Glycogen is absent from the muscles. The muscles normally combust carbohydrates and thus produce energy; in diabetes they are unable to do so owing to the absence of pancreatic secretion (insulin).

FAT METABOLISM.—The metabolism of fat is abnormal, but at present obscure. Results in the formation of ketones (see ACIDOSIS). Lipæmia may even occur.

IS FAT CONVERTED INTO SUGAR IN DIABETES?—Administration of fat has little, if any, influence on amount of sugar excreted, hence it has long been believed that fat is not converted into sugar. Fat might be used by muscles for production of energy without directly affecting amount of sugar in blood, and this action is suggested by the facts in the following paragraph.

RESPIRATORY QUOTIENT.—When dextrose is completely combusted, CO_2 output equals oxygen intake, i.e., respiratory quotient $\frac{\text{CO}_2}{\text{O}_2} = 1$. For higher fats quotient is about 0.7 and for proteins is lower. The normal quotient is 0.9; in diabetes it falls to a figure varying with severity down to 0.7. This indicates that energy is obtained not solely from sugar but also from fats and possibly protein.

General Theory of Diabetes.—

1. The internal secretion of the pancreas (insulin) is deficient in amount.
 2. The muscles, in the absence of insulin, are unable to combust dextrose for the production of the energy necessary for their contractions.
 3. The muscles, unable to distinguish between dextrose which they cannot utilize and dextrose which does not exist, send forth increasing calls for carbohydrate which result in increased sugar production by the liver.
 4. This increased production of useless sugar results in (i) hyperglycæmia and glycosuria, (ii) increased strain on and further failure of the already defective pancreas, (iii) consumption of tissues of the body. Thus results the clinical condition of diabetes mellitus.
 5. Ketosis results from abnormal metabolism of fats.
- The essential cause of the disease of the pancreas is unknown.

ACIDOSIS

Acidosis is the term commonly applied to the presence of ketones in the urine and the clinical features associated with such ketonuria; correctly it implies a diminution of the alkali reserve of the blood.

Acidæmia implies an increase in the hydrogen-ion concentration in the blood. There are many causes for such changes.

Diabetic acidosis (and other forms with carbohydrate starvation) is due to presence of ketones produced by incomplete combustion of fat in absence of sufficient normal metabolism of carbohydrates.

The Ketone Bodies.—These are: (i) β -oxybutyric acid, $\text{CH}_3\text{.CHOH. CH}_2\text{.COOH}$; (ii) Aceto-acetic acid (often called incorrectly 'diacetic acid'), $\text{CH}_3\text{.CO. CH}_2\text{.COOH}$; and (3) Acetone, $\text{CH}_3\text{.CO. CH}_3$. Of these the toxic body is aceto-acetic acid, which in the 'enolic' form $\text{CH}_3\text{.C(OH):CH. COOH}$ stimulates the respiratory centre.

ORIGIN OF KETONE BODIES.—

- a. FROM FAT.—Main source in diabetes. The successive steps in fat metabolism by *normal* oxidation are believed to be: (i) butyric acid; (ii) β -oxybutyric acid; (iii) acetic acid; (iv) CO_2 and H_2O . In diabetes, fat metabolism is abnormal, ascribed to deficient oxidation, which may be due to: (1) Conversion of fat into sugar (Poulton)—probably correct; or (2) Disturbance from insufficient metabolism of carbohydrates (von Noorden). The steps thus become: (i) butyric acid; (ii) β -oxybutyric acid; (iii) aceto-acetic acid; (iv) acetone.

The liver partially *reduces* the poisonous aceto-acetic acid to harmless β -oxybutyric acid, but increasing amounts escape into the circulation.

- b. FROM PROTEIN.—Probable additional source in severe diabetes. Amino-acids, e.g., leucin, are closely allied to fatty acids.

Acidosis—continued.

Acidosis and Acidæmia.—The reaction of a fluid is usually expressed as the concentration of hydrogen ions. For water, using the Sorensen notation, $pH = 7.07$. Normal blood is slightly alkaline, pH between 7.34 and 7.47.

The problem of acidosis of the blood and acidæmia is complex owing to the numerous substances involved. The compounds chiefly concerned are sodium bicarbonate (the alkali reserve) and carbon dioxide. The following points may be noted :—

- a. The addition to the blood of moderate amounts of acid does not alter its reaction, owing to the presence of such salts as carbonates and phosphates and complex substances such as hæmoglobin and protein which act as 'buffers'.
- b. The reaction of the blood—viz., the H-ion concentration—is, normally maintained constant in the body by varying, as may be necessary, the concentration of CO_2 (i) *dissolved* in blood as H_2CO_3 and acting as a weak acid, and (ii) *combined* in blood as $NaHCO_3$, and acting as a weak base. This is expressed as :—

$$K \text{ (constant)} = \frac{H_2CO_3}{NaHCO_3}$$

The following two disturbances may be considered :—

- i. If the dissolved CO_2 becomes increased, the acidity stimulates the respiratory centre, respiration becomes deeper and more frequent, CO_2 is washed out of the blood, and the normal reaction is re-established. Percentage of alveolar CO_2 thus falls.
- ii. If the $NaHCO_3$, the alkali reserve, becomes too high, alkali can be excreted by the kidney.
- c. The immediate effects of the presence in the blood of an acid such as aceto-acetic acid are briefly :—
 - i. Respiration is stimulated, CO_2 is washed out of the blood, and H_2CO_3 assumes a lower level.
 - ii. Some acid combines with the alkali and is excreted : hence the $NaHCO_3$ also assumes a lower level.
- d. If the amount of aceto-acetic acid further increases, the results are :—
 - i. Kidney decomposes urea and produces ammonia which combines with and neutralizes acid.
 - ii. Acid is excreted by the kidney.

Finally these methods fail to control the acid, and in later stages excretion by the kidney may diminish.

TESTS FOR ACIDOSIS.—

- a. URINE: PRESENCE OF 'KETONE BODIES'.—(i) Aceto-acetic acid and acetone: Rothera's sodium-nitroprusside test.
- (2) Aceto-acetic acid: Gerhard's ferric chloride test. No simple test for β -oxybutyric acid.

Note 1.—Ferric chloride is a fairly sensitive test for aceto-acetic acid, but does not react with acetone. Rothera's test reacts with acetone, but is also an

extremely delicate test for aceto-acetic acid (1 part in 400,000): positive test is usually due to latter and is no proof of presence of acetone, even if ferric chloride reaction is negative. A positive Rothera with a negative Gerhardt test is a rough quantitative measure, and this degree of acidosis is not of immediate danger clinically.

Acetone is largely produced by decomposition of aceto-acetic acid subsequent to excretion by kidneys.

Note 2.—High percentage of NH_3 .—Of total urinary N, about 3 per cent is normally excreted as NH_3 . Above 5 per cent suggests acidosis: is often 20 to 30 per cent or higher. (Urea N may be used for total N in approximate calculation of percentage.) *Rise precedes ketonuria.*

b. ALKALI RESERVE.—Expressed by volume of CO_2 which blood can absorb. Normal (for plasma): 55 to 70 vols. per 100 c.c. blood. *Acidosis:* 25 to 30 vols.; *pH* rises to 7.25.

c. ALVEOLAR CO_2 .—Normal: 4.5 to 6.2 per cent. *Acidosis:* falls to 2 per cent.

Causes of Acidosis.—Variety of conditions involving rapid destruction of fat with shortage of carbohydrates—e.g., starvation, vomiting (vomiting in absence of ketonuria may cause alkalosis), toxic effects on liver. They may be tabulated as follows:—

1. *Diabetes.*—Especially with constipation, sepsis, and infections.
2. *Starvation.*
3. *Cyclical Vomiting.*
4. *Migraine.*
5. *Pernicious Vomiting of Pregnancy.*
6. *Administration of Acids.*—(As for *B. coli* infections.)

Also in: (7) Nephritis; (8) Acute yellow atrophy of liver and chloroform poisoning; (9) CO_2 poisoning.

Symptoms.—(Vary with cause.) Nausea, vomiting, pain in epigastrium or throat. Air hunger, pyrexia, headache. May be neuritis. In diabetes, progresses to coma.

Treatment.—Varies with cause: in general, give glucose and withhold fat. (See DIABETIC COMA, p. 344.)

ALKALOSIS.

Alkalosis is the reverse of acidosis and implies an increase in the alkali reserve. Alkali reserve may be 80 to 90 vols. per 100 c.c. plasma, and *pH* of blood less than 7.5.

Causes.—Alkalosis may arise from various causes, including:—

1. INCREASE IN ALKALI RESERVE.

- a. MASSIVE DOSAGE WITH ALKALIS.*—In treatment of peptic ulcers, or chronic nephritis with œdema. Normal tolerance not less than 15 gm. sod. bicarb. in 24 hours. Alkalosis aided by anæmia, renal disease, and vomiting. May develop after one week of treatment.

Alkalosis—Causes, continued.

- b. LOSS OF CHLORIDES FROM THE BODY.**—(i) Persistent vomiting, e.g., pyloric stenosis; (ii) Prolonged stomach washes (formerly in gastric atony); (iii) Diarrhoea (rare); (iv) Fireman's cramp (lost in sweat). Loss of chlorides from plasma necessitates retention of alkalis to maintain osmotic pressure of blood, and hence alkalis not excreted: alkalosis here outweighs the acidosis of vomiting.
- c. RAPID RESPIRATION AT REST.**—(i) Voluntary; (ii) Hysteria (is cause of fainting). CO_2 is washed out of blood rapidly.
- 2. DECREASE IN ALKALI RESERVE WITH GREATER DECREASE IN H_2CO_3 OF BLOOD.**—Associated with lack of oxygen (anoxæmia) as in: (i) High altitudes; (ii) Cardiac failure; (iii) Pneumonia. In ascending to high altitudes (over 11,000 feet) lack of oxygen causes deep respiration, washing out CO_2 ; kidneys secrete alkalis to balance (urine alkaline), but CO_2 loss is greater and pH of blood falls.

Rise in Blood-urea.—Kidney fails to secrete urea (assists to maintain osmotic pressure); blood-urea rises; death in uræmia can occur without renal disease in alkalosis.

Symptoms.—Complicated by tetany and uræmia.

AT ONSET.—Anorexia, malaise, headache; thirst, nausea, vomiting, and constipation; dizziness; tenderness, tingling and pains in limbs and increased muscular irritability.

PROGRESS.—Nervous, irritable, resentful, and drowsy (may resemble delirium tremens). Tetany or epileptiform convulsions.

FINALLY.—Comatose.

Physical Signs.—Pulse rapid, respiration slow; may be pyrexia. Sweating, face flushed, tongue dry. Blood-pressure rises. Blood-urea raised. *Urine*: may be polyuria, albumin, casts, chlorides low; alkaline (or acid in early stages).

Treatment.—Stop alkalis if given (usually sufficient). Glucose by mouth or intravenously. Acid sodium phosphate, gr. xxx, every 4 hours. *See also* TETANY.

CHAPTER LXVIII.

OBESITY AND OTHER LIPOMATOSES.**OBESITY.**

An excessive deposit of fat. The condition is only a symptom, and the causes are various.

Etiology.—

RACE.—Common in certain races, especially Eastern.

HEREDITY.—A definite factor.

SEX.—Females predominate: partly connected with internal secretions.

Pathogenesis.—

1. **EXOGENOUS.**—Excessive intake: especially heavy consumption of fats, carbohydrates, beer. Basal metabolic rate: normal.
2. **ENDOGENOUS.**—Lessened consumption in body. Endocrine disturbances include: (a) Sexual: increase of fat common at puberty (females), menopause, pregnancy; after castration. (b) Pituitary. (c) Thyroid. (d) Suprarenal. (See under the various glands.) Basal metabolic rate: low.
3. **CONSTITUTIONAL.**—Maintain or gain weight in contradiction to usual caloric standards. Hereditary factor in 80 per cent. No gross endocrine defect.

See also **WATER RETENTION TYPE**, p. 360.

Morbid Anatomy.—Great increase of fat in all sites where normally found, e.g., subcutaneous, omentum. Fatty infiltration of heart invariable. Various complications.

Symptoms.—(1) *Increased size*, alteration of personal appearance. (2) *Sweating*. (3) *Fatty myocarditis*, viz., shortness of breath, cardiac pains and weakness. (4) *Sleepiness*. (5) Psychological disturbance as to appearance. General health may be good.

BASAL METABOLIC RATE.—Estimate (see above).

BLOOD-SUGAR CURVE.—Variable: may be flat or high.

Complications.—(1) From muscular weakness, e.g., umbilical and other herniæ. (2) Metabolic: gout, glycosuria. (3) Respiratory and cardiac troubles: bronchitis; cerebral hæmorrhage in the plethoric type. Pneumonia and anæsthetics badly borne.

Diagnosis.—Usually simple. In *myxædema*, skin dry and harsh.

Prognosis.—Expectation of life diminished by tendency to complications.

Treatment.—Involves (a) restriction of diet; (b) regulation of exercise. Severity of restriction of diet depends on degree of obesity and opportunities for treatment. Heart to be watched. Weight to be recorded regularly.

MODERATE DEGREES.—Restriction of diet to 1300 to 1500 calories on following principles:—

1. **FAT.**—Great restriction: total 40 to 60 gm. No butter, ham, bacon, fat of meat, cream; little milk.
2. **PROTEIN.**—Not restricted: about 70 gm.
3. **CARBOHYDRATE.**—Moderate restriction: about 150 gm. (Great restriction tends to produce hypoglycæmia, depression, and refusal of treatment.)
4. **FLUIDS.**—Not limited.

A weekly fast day may be enjoined.

Loss of weight: $1\frac{1}{2}$ to 3 lb. a week.

SPECIMEN DIET.—

7.30 a.m. and 10 p.m.: Hot water.

8.30 a.m.: Cup of meat extract.

1 p.m.: Soup, meat, 5 ounces. Green vegetables, 6 ounces.

Digestive biscuits, 1 ounce. Fresh fruit, 4 ounces.

Obesity—Treatment—Specimen Diet, continued.

4.30 p.m.: Tea. Bread, 1 ounce. Milk, 3 ounces.

7.30 p.m.: as lunch.

Daily allowance of butter, $\frac{1}{2}$ ounce.

RAPID REDUCTION.—Confine to bed. Diet 300 and 500 calories daily, alternate days. Loss of 14 lb. in 2 weeks. Continue on diet as above.

Vitamins A and D to be added—e.g., as radiostoleum or adexolin.

EXERCISE AND GENERAL HYGIENE.—*Exercise* regulated during strict diet: excessive exercise—often attempted by subjects—always fails to reduce obesity, and often increases it, *unless diet is controlled.*

DRUGS.—*Thyroid extract* only constantly effective drug: *acts also on protein tissues*, and hence needs careful watching: dose begins with gr. $\frac{1}{2}$ b.d. (dry extract): give plentiful protein in diet: heart also must be carefully watched: not with strict diet. Little value if basal metabolic rate normal. *Dinitro-ortho-cresol* increases basal metabolic rate and causes loss of weight, but administration is dangerous.

BERGONIE'S METHOD.—Muscles, stimulated electrically, contract against resistance of sand-bags. Reduces weight. Heart needs watching. Rapid recurrence.

Water Retention Type.—Rare. Cause unknown. Young subjects, 12 to 30 years. Pallor but no pitting. Appetite small. Urine: quantity small, about 1 pint on normal intake. Reduction of weight slight on restriction of diet to 500 to 700 calories.

TREATMENT.—(1) Rest in bed essential. Urine rises several pints daily. (2) Fluid: 1 to 2 pints daily. (3) Salt-poor diet. (4) Diet: 700 to 1000 calories. Salyrgan may be given.

Obesity in Children.—Constitutional type common. May disappear at puberty, but frequently does not. Amenorrhœa common. Dietetic treatment advisable. Thyroid contra-indicated.

OTHER LIPOMATOSSES.

1. Adiposis Dolorosa (Dercum's disease).—Four characteristics described: (1) Obesity; (2) Pain and tenderness of fat; (3) Asthenia; (4) Psychical changes.

ETIOLOGY.—Females preponderate: usually in middle age. Syphilis, alcoholism, and traumatism have been recorded; also pituitary tumours.

SYMPTOMS.—Several types described: (1) *Localized form*; (2) *Diffuse form*. Obesity usually present previously, but rarely the painful areas are the only deposits of fat.

LOCALIZED FORM.—With previous obesity, there occurs a *painful local area*: usually slightly raised and reddened: diameter few inches: subsides in a few days, leaving *distinct painful nodule*. Recurs in other areas. After many attacks,

may cease, but the multiple painful nodules remain. No special nerve distribution.

Distribution.—Back, neck, upper chest, arms, and thighs. Face, hands, feet always escape.

DIFFUSE FORM.—Entire fat tender, but no local areas or nodules. Probably a different condition.

TREATMENT.—Palliative. Sedatives.

Note.—It is doubtful whether this condition should be described as an entity. Localized form is due probably to lymphatic disturbance in fatty tissue with some inflammation (cf. elephantiasis). In *diffuse form* pain is probably a neurosis and in moderate degrees is common: is separate from other type, which may be referred to as Dercum's disease. Cases with marked asthenia and psychical changes are sometimes manifestations of pituitary tumours.

2. Lipoma.—Local innocent encapsulated tumour of fatty tissue. Often multiple. May be painful.

3. Diffuse Lipomatosis of Neck.—Increase of fatty tissue around neck: may be enormous. Almost always in alcoholic males. May be local lipomata, general obesity, or sometimes wasting. Also termed 'adeno-lipomatosis', as tissue may contain lymphatic glands.

CHAPTER LXIX.

HÆMOCHROMATOSIS.

(*Diabète bronzé.*)

A rare disease, probably due to an inborn error of metabolism of iron, characterized pathologically by deposition of iron-containing and other pigments in the tissues, and clinically by widespread pigmentation, by cirrhosis of the liver and other organs, and usually by diabetes.

Etiology.—Age: 30 to 60 years. Almost unknown in women. No predisposing factors known. Hereditary and familial cases recorded.

Morbid Anatomy.—General pigmentation of tissues, brown or slaty colour.

LIVER.—Large, smooth, brick-red. Histology: (1) Pigment very abundant in liver cells and fibrous tissue; (2) Multilobular cirrhosis. 'Primary' carcinoma occasionally.

LYMPHATIC GLANDS.—Pigment enormous. Structure almost destroyed.

SPLEEN.—Enlarged; pigmented. Fibrosis varies.

PANCREAS.—Pigmented and fibrotic.

HEART AND INTESTINES.—Pigment less.

Hæmochromatosis, continued.

Nature of the Pigment.—Two forms: (1) *Hæmosiderin*, iron-containing pigment, in liver, lymphatic, and other glands; (2) *Hæmofuscin*, iron-free, a melanin pigment, containing sulphur, in heart and smooth muscle.

AMOUNT OF PIGMENT AND IRON IN BODY is enormous. Iron may be 40 gm., 30 gm. in liver (Muir and Dunn): normal total in body is 2 gm., and daily ingestion in food 10 to 30 mgm.

Pathogenesis.—Note:—

1. Retention of iron must be almost complete for years.
2. No increased hæmolysis, i.e., no anæmia, and no hyperplasia of bone-marrow. Pigment moderate in spleen and kidneys.

The condition is due to an inborn error of metabolism affecting metabolism of iron, resulting in production of hæmosiderin, and probably also affecting metabolism of protein, resulting in formation of hæmofuscin (Sheldon).

Other Theories (discredited).—Special form of cirrhosis. Chronic copper poisoning.

Symptoms.—Very chronic. Take many years to develop. *Due to effects of deposits.* (1) *Pigmentation of skin* (may be absent): Brown to slate colour; mainly on exposed parts; also common on buccal mucous membrane. (2) *Enlarged liver and spleen*: Smooth and uniform. Ascites, etc., develop. (3) *Diabetes*: Occurs in 80 per cent; late in disease, but severe and rapid; blood-sugar enormous. (4) *Endocrine defects*. Note: Addison's disease may coexist and cause its specific pigmentation.

Prognosis.—Chronic, but finally bad from cirrhosis and diabetes.

Diagnosis.—From: (1) *Addison's disease*, by glycosuria and enlarged liver and spleen. (2) *Hypertrophic biliary cirrhosis*, by absence of jaundice and presence of glycosuria. (3) *Splenic anæmia*. (4) *Lipoidoses*.

SPECIAL TESTS: (1) Biopsy of skin; (2) Urinary deposit may show intracellular granules of hæmosiderin.

Treatment.—As in diabetes (controlled by insulin) and cirrhosis of liver.

Section IV.—Diseases of Metabolism and Diseases of Deficiency, *contd.*

B. DISEASES OF DEFICIENCY.

CHAPTER LXX.

VITAMINS.

Natural foods contain certain constituents present in minute amounts; but if these be removed, such foods are unable to support nutrition, and symptoms of actual disease develop. These constituents are unconnected with the supply of energy and protein, yet they are necessary for complete normal metabolism.

These substances are known as 'vitamins'. They are present in all natural diets of men and animals, and are present in sufficient supply in food so long as it is reasonably varied, has not been separated into parts artificially or accidentally, and has not been exposed to any destructive process. But they are not invariably present in sufficient amounts in the diet under special circumstances, and in the diet of childhood and the period of growth. They are apparently formed only in the tissues of plants, and cannot be synthesized in the animal body, with the exception of vitamins A and D.

Vitamins at present recognized are:—

1. FAT-SOLUBLE.—

VITAMIN A.—*Source*: Carotene. Identified and synthesized: is an alcohol. *Disease*: Xerophthalmia (keratinization). *Food-stuffs*: Milk products, fish-liver oils, etc., green vegetables. Can be formed in body from carotene.

VITAMIN D (Calciferol).—*Source*: Cholesterol. Identified and synthesized. *Disease*: Rickets, etc.: calcium and phosphorus metabolism. *Food-stuffs*: Fish-liver oils. Formed in body from cholesterol.

VITAMIN E.—Not identified. *Disease*: Sterility. *Food-stuffs*: Wheat-germ oil, lettuce.

2. WATER-SOLUBLE.—

VITAMIN B₁ (Aneurin).—*Source*: Germ of cereals. Identified and synthesized. *Disease*: Beri-beri. *Food-stuffs*: Widespread. Vitamins B₂, B₄, and B₆: growth-factors: associated with B₁.

VITAMIN B₂.—Identified partly as flavin. *Disease*: Pellagra and dermatitis. *Food-stuffs*: Widespread.

VITAMIN C (Ascorbic Acid).—Identified and synthesized: is a carbohydrate. *Disease*: Scurvy. *Food-stuffs*: Lemons, green vegetables.

FAT-SOLUBLE VITAMINS A, D, and E.—Possess following properties:—

- a. Present in the 'unsaponifiable residue'—about 1 per cent—of fats in which they occur—i.e., are stable to alkalis in conditions employed in hydrolysis of fats.

Vitamins, continued.

- b. Soluble in fats and fat solvents—e.g., ether. Very slightly in water.
- c. Comparatively resistant to heat.
- d. Oxidation causes rapid destruction.
- e. Destroyed in hardening oils by action of hydrogen, method used in preparation of edible fats.

DISCOVERY OF VITAMINS: EXPERIMENTS WITH PURIFIED DIETS.—

LUNIN, 1881.—Animals died in one month on artificial purified diet containing the supposed essential ingredients of milk, viz., caseinogen, milk-fat, milk-sugar, and ash of milk.

At the time this was attributed to: (1) Monotony of diet. (But pure milk will sustain life.) (2) Lack of flavouring, and hence loss of appetite.

Beri-beri had been largely elucidated before the following researches were published.

OSBORNE AND MENDEL, 1911.—Rats died on diets composed of isolated food substances, viz., starch, sugar (lactose), lard, inorganic salts, with agar as a basis.

STEFF, 1911-12.—Mice died on diets, otherwise satisfactory, but extracted with alcohol and ether, but could be saved by addition of these extracts.

HOPKINS, 1912.—Young rats died rapidly on a diet of purified food substances, but lived and grew on addition of milk (4 per cent of diet), milk extracts, or yeast. He concluded that some 'accessory food factors' were essential for growth in young animals, as he had suggested previously in 1906.

OSBORNE AND MENDEL, 1913.—Discovered that the active substance was concentrated in the butter-fat fraction of milk. Also was found to accompany the fat when extracted with ether.

Until the following research, this was believed to be the only accessory substance necessary to supplement a diet of purified constituents in order to produce growth.

MCCOLLOM AND DAVIS, 1915.—Study of rice diets proved the existence of a second accessory factor essential for normal nutrition during growth. They named the two factors now known: (1) *Fat-soluble A*; (2) *Water-soluble B*.

Also proved that *Water-soluble B* is present in milk and separated with difficulty from milk sugar; this explains its previous escape from observation, since it was present in lactose used as sugar in many experimental diets.

Vitamin A. Fat-soluble.—Primary source is carotene, a reddish hydrocarbon present in: (1) All green plant tissue, including marine algæ (whence in fish); (2) Certain roots and fruits (carrots, palm-fruits). In animal tissues, carotene is broken down into vitamin A.

Vitamin A is an alcohol, $C_{20}H_{30}O$; yellowish viscous fluid; fairly stable, resists ordinary cooking and boiling. Carotene and vitamin A have same effect, but latter is more potent and more easily absorbed from intestine.

PRESENCE IN FOOD SUBSTANCES.—

PRESENT IN: (1) Green vegetables (as carotene); (2) Fats—fish-liver oils and many animal fats and oil; (3) Milk, butter, cream. (4) Meat and fish—liver, kidneys, etc.

Animal tissues have fair reserves but less in winter.

ABSENT FROM: (1) Vegetable oils (prepared from seeds), e.g., olive oil, cotton-seed oil, linseed oil. (2) Lard. (3) Yeast. (4) Malt extract. (5) Meat extracts.

In accordance with above, absent from: white bread; salad and frying oils; margarine, except when prepared from animal fat (other than lard); custard powders and egg substitutes. Deficient in most patent and proprietary foods.

COLOUR TEST.—Antimony trichloride gives blue colour in presence of vitamin A: can be compared quantitatively in Lovibond's tintometer.

ACTION OF VITAMIN A.—Is concerned with general nutrition of cells. In its absence, development of *keratinization*—viz., thickening of epithelium, with tendency to secondary infection; effect widespread. Note:—

1. XEROPHTHALMIA.—Corneal epithelium thickened, necrosis and infection may follow; no lachrymal gland secretion; inflammation in anterior and posterior chambers; may lead to complete blindness. Specific of vitamin A deficiency.
2. HEMERALOPIA (night blindness).—Vitamin A is essential for regeneration of visual purple in retina.
3. Tendency to sepsis.
4. Growth is affected. Young rats grow for a short period: then weight becomes stationary: death usually from septic complications. Adults able to live for long periods: general health suffers.

HUMAN REQUIREMENTS.—

INTERNATIONAL UNITS (measured on growth of young rats).—*Adult*: needs 2000 daily. *Child*: 3000 daily (contained in one teaspoonful of cod-liver oil).

Units contained in 1 gramme: milk, 3 to 5; butter, about 60; cod-liver oil, 1000; halibut-liver oil, 160,000.

VITAMINS A AND D.—Cod-liver oil heated until no longer able to prevent xerophthalmia was found still able to cure rickets. This led to discovery of vitamin D.

Vitamin B Complex. Water-soluble.—Present especially in seeds and eggs of animals. Easily extracted. Vitamin B complex contains two groups: (a) Vitamin B_1 (aneurin): associated with which are B_3 , B_4 , and B_5 ; (b) Vitamin B_2 , including flavin (' B_2 ') and another vitamin (B_6), pellagra-preventive. Knowledge incomplete and advancing.

Vitamin B Complex, *continued*.

PROPERTIES.—

1. Soluble in water. Also alcohol, but not in the other fat solvents.
2. Moderately resistant to heat.
3. Very resistant to drying and oxidation.
4. No colour test known.

DISTRIBUTION IN FOOD SUBSTANCES.—Especially present in seeds and eggs of animals.

PRESENT IN: (1) Cereals and pulses. In cereals is contained mainly in the embryo. In pulses is distributed throughout seed. (2) Eggs, fresh and dried. (3) Yeast (can synthesize B). (4) Vegetables; potatoes (moderate). (5) Meat, fish-roe, milk, liver, kidney (in moderate degree).

ABSENT FROM: Fish, fats of all kinds, meat extracts; also from *polished rice* and white bread (embryo removed in machine milling).

COMPLETE VITAMIN B DEFICIENCY.—Rats on such diet die rapidly without paralysis or dermatitis.

VITAMINS B_1 and B_2 .—Wheat embryo: rich in B_1 , poor in B_2 . Milk, meat, green leaves, potatoes, roots: poor in B_1 , rich in B_2 . Egg-white: contains B_2 , no B_1 .

SOLUBILITY.— B_1 more soluble than B_2 in alcohol.

VITAMIN B_1 (aneurin).—Anti-neuritic. Heat-labile. Destroyed at 120°C ., and thus absent from tinned and autoclaved foods. Has been isolated in pure crystalline form and synthesized. Formula: $\text{C}_{12}\text{H}_{16}\text{ON}_4\text{S} \cdot 2\text{HCl}$; constitution uncertain, contains pyrimidin and thiazole groups.

PRESENT IN: Germ of seeds abundantly; little in leaves and fruit, yeast. In nearly all natural food-stuffs except egg-white, honey, and endosperm of cereals. Rich in egg-yolk and liver. Separated by adsorption in fuller's earth.

INTERNATIONAL UNITS.—Average diet contains 200 to 500 daily; requirements possibly 500 to 750; in pregnancy 3,000.

EFFECTS OF ABSENCE.—(1) Beri-beri in man; (2) Polyneuritis in birds; (3) Inanition and loss of appetite—is essential for growth and maintenance of health in adults; (4) In man, may be connected with peptic ulcers. Has some part in carbohydrate metabolism.

STORAGE.—Animals possess limited store of B_1 : in man exhausted in 90 days.

VITAMINS B_3 , B_4 , B_5 . FACTOR Y.—Vitamins necessary for growth of animals. Elucidation incomplete.

VITAMIN B_2 .—Also known as vitamin G and P-P (pellagra-preventive). Heat-stable.

PRESENT IN: Yeast. Milk, meat, green leaves, vegetables, roots. Egg-white. Scanty in wheat germ.

FLAVIN AND B_2 .—A yellow pigment, flavin, is present in all substances acting as B_2 . Flavin, isolated from egg-white, cures dermatitis produced by B_2 deficiency and hence was regarded as B_2 . But synthetic flavin does not do so, though

is concerned with oxidation in all cells, and is an essential growth factor. Anti-pellagra and anti-dermatitis factor is apparently another vitamin ('B₆'), is present in B₂ concentrates after removal of flavin, but not yet isolated.

No international units. B₂ acts only in presence of B₁ (or B₄).

EFFECTS OF ABSENCE.—(1) Pellagra in man; (2) Growth ceases in growing animals—loss of weight, gastro-intestinal disturbances; (3) Black tongue in dogs, skin lesions in rats.

Relation to Anæmia.—Vitamin B₂ or some closely associated substance is connected with the development of megaloblastic anæmia (see GENERAL CONSIDERATION OF ANÆMIA).

AVIAN POLYNEURITIS.—Fowls and pigeons are very susceptible to beri-beri diet and absence of vitamin B. Onset of symptoms in 15 to 25 days: death in 24 to 48 hours in absence of treatment. Symptoms: weakness of legs, wing-drop, head retraction, general paralysis. Cured by administration of vitamins, e.g., yeast, alcoholic extract of rice polishings (by mouth or by injection). Recovery on treatment is extraordinarily rapid. A bird *in extremis* may be flying about within 2 hours of an injection, apparently in perfect health.

Note.—The absolute identity of avian polyneuritis and beri-beri is not quite certain.

Vitamin C. Ascorbic Acid. Water-soluble.—Scurvy was recognized in the 17th century to be due to long deprivation of fresh foodstuffs, and its prevention and rapid cure by fresh vegetables and fruit juice were known.

PROPERTIES.—

1. Very sensitive to drying, and rapidly destroyed thereby.
2. Very sensitive to heat. Temperature of 60° C. for one hour destroys 80 per cent. The rate of destruction does not increase very rapidly with further rises of temperature.
3. Rapidly destroyed by alkalis and oxidation.
4. Protected by acids against heat and oxidation.
5. Soluble in water and in alcohol.

Note.—Foods tinned and autoclaved in absence of oxygen can retain potency. Fruit juice can be safely concentrated by evaporation *in vacuo*.

DISTRIBUTION IN FOOD SUBSTANCES.—Present in plant tissues in which active metabolism is taking place.

PRESENT IN: (1) Fresh vegetables, especially cabbages (raw or cooked), onions, juice of swedes; sufficiently in potatoes (cooked). (2) Fruit juice, especially of oranges and lemons (fresh or preserved juice). (3) Raw meat juice, milk, and certain dried fruits to a moderate extent. (4) Dried and condensed milk if air excluded in preparation.

ABSENT FROM: Dried vegetables, dry cereals and pulses, tinned and autoclaved foods (unless prepared anaerobically); jams and marmalade; yeast.

GERMINATED PULSES AND CEREALS.—Though absent from dry pulses and cereals, the vitamin *appears* in these if soaked in water and allowed to germinate for a few days.

Vitamin C—Distribution in Food Substances, *continued*.

MILK.—Whole milk contains bare sufficiency ; just enough on complete milk diet. Potency slightly reduced by scalding ; more (and variably) by pasteurization ; greatly or completely by sterilization.

'LIME JUICE'.—Formerly was known to cure or prevent scurvy, but evidence has accumulated of its failure to do so in recent Polar and similar expeditions. This failure has led in recent decades to other theories for scurvy, such as tainted meat. Experiment proves that preserved lime juice contains no anti-scorbutic vitamin. The explanation is that until 1850 'lime juice' was really prepared from Mediterranean lemons. Since then West Indian limes have been used, the preserved juice of which is not anti-scorbutic. Investigation shows that since this date lime juice has never prevented or cured scurvy (Henderson Smith).

ASCORBIC ACID.—Hexuronic acid : a carbohydrate, $C_6H_8O_6$. Isolated from suprarenal cortex and from paprika. Also prepared synthetically. Both products cure or prevent scurvy. Identified as vitamin C.

INTERNATIONAL UNIT.—1 unit is 0.05 mgm. *l*-ascorbic acid.

REQUIREMENTS.—*Man* : 400 units daily (1 oz. lemon-juice). *Child* : 800 to 1000 units. No evidence of over-dosage. Rapidly excreted in urine.

EFFECT OF ABSENCE.—Scurvy and latent scurvy. Administration also under trial for hæmorrhagic diathesis, hæmophilia, Addison's disease, cataract, dental caries.

Note.—In spite of above results, it is not certain that vitamin C and ascorbic acid are identical. Lemon-juice and extracts of paprika are more effective against permeability of capillary walls.

ESTIMATION OF VITAMIN C DEFICIENCY.—Human body is normally saturated ; hence if a large dose of vitamin C is given, rapid excretion in the urine occurs within few hours. *Method* : Give test dose, for adults 600 mgm, for infants 100 mgm. ascorbic acid. Urine within 3 to 6 hours should contain 5 mgm. per cent. Grade of deficiency measurable by amount of ascorbic acid necessary to obtain this excretion. *Estimation* : Titrate against dichlorophenol-indophenol (Roche) ; rapid and sufficiently accurate. Urine must be tested immediately on passing.

STORAGE IN TISSUES.—Slight. Present normally in muscle and tissue, but C-rich diet does not delay subsequent development of scurvy. Rats and rabbits are almost immune to scurvy, and may form C in body.

Vitamin D. Calciferol. Fat-soluble.—**STEPS IN DETECTION.—**

1. Existence of antirachitic vitamin distinct from vitamin A discovered by heating cod-liver oil : product still cured rickets but did not prevent xerophthalmia.
2. Rickets found to be curable or preventable by irradiating
 - (i) certain inactive foods,
 - (ii) animals on rickets diet.

Hence irradiation forms vitamin D. (Confirmed previous observations that sunlight cured rickets.)

3. Antirachitic fraction in cod-liver oil confined to 'unsaponifiable residue': this contains cholesterol.
4. Cholesterol, as ordinarily prepared from natural sources, is not antirachitic, but becomes so after irradiation. Chemically pure cholesterol is incapable of 'activation'. Therefore traces of another substance must be precursor of vitamin D.
5. Spectrum of natural cholesterol shows absorption bands in the ultra-violet disappearing after irradiation.
6. Ergosterol found to possess these bands. On irradiation gives vitamin D richly, and bands disappear.
7. Ergosterol is sole precursor of vitamin D.
8. Irradiation of ergosterol produces vitamin D, but longer exposure destroys it. Maximum effect in about half an hour.

PRESENCE OF ERGOSTEROL IN NATURE.—Present in: (a) All natural cholesterol—this is richly present in skin; (b) Nearly all animal and vegetable fats; (c) Yeast and fat of certain fungi—e.g., ergot of rye.

FORMATION OF VITAMIN D IN NATURE.—Formed in animal body by action of sunlight on ergosterol in cholesterol of skin. Liver stores vitamin during summer.

SOURCES OF VITAMIN D.—

1. **COMMON FOOD-STUFFS.**—Milk, butter, and cream are main natural sources, but content not large and diminishes in winter. Eggs are rich.
2. **ADDITIONAL NATURAL SUPPLIES.**—Fish-liver oils, especially cod and halibut.
3. **IRRADIATED ERGOSTEROL.**—By irradiation of vegetable and other oils containing ergosterol.

CALCIFEROL.—Pure crystalline vitamin D, synthesized: 1 mgm. contains 40,000 international units.

International Units.—In 1 gm.: butter, 0.4 to 4; cod-liver oil, about 100; halibut-liver oil, 2400.

Note.—A unit is a 'curative' dose for rachitic rats under certain fixed conditions.

ACTION OF VITAMIN D.—Connected with calcium and phosphorus metabolism and bone formation. Over-dosage is possible.

DEFICIENCY produces: rickets, osteomalacia, osteoporosis, dental caries, and tetany (in certain circumstances).

(See **CALCIUM AND PHOSPHORUS METABOLISM**; **PARATHYROID GLANDS**; **RICKETS**; **OSTEOMALACIA**; **TETANY**.)

Vitamin E. Fat-soluble.—Rats on certain diets, rich in vitamins A, B, C, and D, grew but were sterile. Necessary vitamin richly present in wheat-germ oil: also present in milk, lettuce, meat, whole wheat. Apparently necessary for fertility. Reported isolated as an alcohol, a colourless viscous oil.

CHAPTER LXXI.

BERI-BERI.(Kakhé. *Endemic Multiple Neuritis.*)

A disease of deficiency due to the absence from the diet of vitamin B₁, and characterized by multiple peripheral neuritis, and by cedema, effusions, and cardiac weakness.

Beri-beri is the prototype and the first established of the 'diseases of deficiency', and hence of great importance.

Distribution.—In all regions in which rice is the staple diet, and in certain other places and circumstances from local causes. In Japan, parts of China and India, Dutch East Indies, the Philippine Islands, and Malay, affects large numbers.

Pathogenesis.—

A 'disease of deficiency' due to absence of vitamin B₁ (*see* p. 366). An association of beri-beri with rice dietary was early noted by many observers, but for long was not generally accepted. Important steps in the brilliant work elucidating this disease are:—

TAKAKI in 1884 eradicated the disease from Japanese Navy (from 30 to 40 per cent to under 1 per 1000) by adding meat and milk to rice diet. His explanation was obviously erroneous, viz., deficiency of nitrogen according to Voit's Standard. Consequently, in spite of success, his views and measures were generally unaccepted.

EIJKMANN, 1890, produced '*polyneuritis gallinarum*' in fowls on diet of cooked rice, and asserted identity with human beri-beri.

VORDERMAN, 1895, proved experimentally in Java prisons that disease was produced by polished rice, and cured or averted by unpolished rice. This attracted no attention.

GRIJNS, 1901, repeated Eijkmann's experiments, and proved that a bean, Katjang idjo (*Phaseolus radiatus*), was protective and curative for fowls on polished rice diet.

HULSHOFF POL, 1901-1904, applied this to human beings, and found 150 gm. of the bean daily to be similarly protective and partially curative.

BRADDON, 1907, in monograph on beri-beri, showed that disease followed use of polished rice and was prevented by cured or parboiled rice. This was first accepted proof that condition was due to rice. Ascribed to *toxins* developing in rice deprived of pericarp.

SCHAUMANN ascribed disease to removal of phosphates in aleurone layer: but phosphorus, inorganic, or organic, failed to cure or avert condition.

FRASER and STANTON, 1907-1908, proved etiology definitely.

1. Two parties of coolies fed, the one on polished and the other on unpolished rice: then vice versa. Beri-beri always occurred in party on polished rice, and was cured by unpolished rice.

2. Beri-beri proved to be a 'disease of deficiency' by following feeding experiments on fowls: (a) Polished rice after extraction with alcohol: beri-beri resulted. The extraction with alcohol was an attempt to remove toxins. (b) Unpolished rice after extraction with alcohol: beri-beri resulted. Decisive experiment, originally performed as control to (a). (c) Polished rice with added extract of unpolished rice: no beri-beri. (d) Undermilled or unpolished rice: no beri-beri.

Therefore milling removes some essential substance from the rice, and beri-beri is a 'disease of deficiency'.

THE RICE GRAIN AND EFFECTS OF MILLING.—A grain consists of: (i) Pericarp or thin outer layer; (ii) Aleurone layer, containing all the *phosphates and fats*; (iii) Germ or embryo; (iv) Endosperm, the bulk of the grain, consists of starch granules. Steam-milling or 'polishing' removes the embryo which contains the vitamin.

OCCURRENCE AND DISTRIBUTION OF BERI-BERI.—Explained by properties and distribution of vitamin. Apart from polished rice diets, outbreaks will occur anywhere if diet is: (a) Deficient in anti-beri-beri vitamins; (b) Sterilized or autoclaved. This explains many outbreaks previously used as arguments against rice theories, e.g., amongst Norwegian fishermen, in ships, jails, and institutions in many lands.

Cause of Symptoms.—Diet deficient in vitamin B₁ is usually deficient also in other factors: latter may account for certain symptoms—e.g., oedema may be due to protein deficiency.

Morbid Anatomy.—Main changes correspond to the three groups of symptoms.

1. **NERVOUS SYSTEM.**—Peripheral nerves: changes characteristic of peripheral neuritis; vagus and phrenic affected. Spinal cord: in chronic cases, degeneration of posterior columns, posterior spinal ganglia, and anterior horn cells.
2. **EFFUSIONS.**—Hydropericardium (3ij to 3viij) in 60 per cent of fatal cases. Oedema of lungs, pleural and other effusions common. General anasarca in 'wet' type.
3. **HEART.**—Characteristic is increase in weight and enlargement, chiefly of right ventricle: probably oedema of muscle.

LIVER, KIDNEYS, SPLEEN.—Some congestion, changes slight.

Etiology.—Young adults commonest; also infants of affected mothers.

Symptoms.—

PERIOD OF DEVELOPMENT.—About 90 days usually elapse on a beri-beri diet before appearance of symptoms.

THREE GROUPS OF SYMPTOMS.—(1) Multiple peripheral neuritis; (2) Oedema and effusions; (3) Cardiac weakness.

TWO MAIN CLINICAL TYPES are recognized, with varying combinations.

1. 'DRY' OR ATROPHIC BERI-BERI.—Onset with weakness of

Beri-beri—Symptoms, continued.

legs and paræsthesia, slight œdema of face and legs, palpitation and cardiac weakness. Then peripheral neuritis marked, paralysis is rapid and widespread, wasting and atrophy severe, with anæsthesia and paræsthesia. No œdema. Cardiac symptoms slight. Becomes helpless.

2. 'WET' OR DROPSICAL BERI-BERI.—Onset as above. Then rapid œdema, anasarca, and effusions: cardiac dilatation and dyspnœa marked. Paralysis slight: atrophy often noted as œdema clears. Heart failure common.

VARIOUS FORMS.—

RUDIMENTARY OR 'LARVAL' BERI-BERI.—Onset as above. May disappear, remain stationary for years, or progress into the other types. Is really mild chronic beri-beri.

ACUTE PERNICIOUS OR CARDIAC BERI-BERI.—Onset as above, or directly with acute cardiac failure, with pain, palpitations, and dyspnœa. Paralysis varies. May be gastro-intestinal symptoms. Rare form, but high mortality. Duration, few days to several weeks.

INFANTILE BERI-BERI.—Causes enormous infantile mortality. McLaughlin and Andrews, 1909, found changes at autopsy identical with adult beri-beri. Chamberlain and Velder, 1912, cured cases by rice polishings.

Symptoms.—(1) *Acute type*: Common. Sudden paroxysmal pain and tachycardia. Repeated attacks. Death within few hours. (2) *Chronic type*: Less common. Vomiting, constipation, tachycardia, and œdema. No paralysis. Death as in acute type.

Age.—One to three months, never over a year. Always breast-fed infants of beri-beri mothers, and due to deficient vitamins in the milk.

Special Features of Symptoms.—

PERIPHERAL NEURITIS.*—Both motor and sensory fibres affected. Lower extremities first attacked. In severe cases widespread, including diaphragm. Sphincters escape. Atrophy rapid. No ataxia. Knee-jerks absent early.

Sensory.—(i) Anæsthesia: constant, all sensations affected, commences over tibiæ (an early and simple test). (ii) Paræsthesia common. Never hyperæsthesia. (iii) Muscles, especially calf, very tender.

ŒDEMA AND EFFUSIONS.—*Œdema*: commences in feet and spreads upwards: in 'wet' type, extreme and generalized. Also in 'wet' type: *œdema of lungs*, common cause of death; *hydrothorax*, often large; *œdema of meninges*. *Hydropicardium*: present in most fatal cases of all types: rarely exceeds 8 ounces.

* When asked to give the causes of multiple neuritis, a student should refrain from mentioning beri-beri first. This reply often has an acute irritant action on an examiner. 'Alcohol' is preferable.

CARDIAC SYMPTOMS.—(i) *Palpitations*, rarely absent; (ii) Dilatation of *right heart*. Apex beat fluttering. Pulse regular, soft, and rapid.

OTHER SYMPTOMS.—*Blood*: anæmia not marked. (In tropics, blood picture often complicated by presence of parasites.) *Urine*: no albuminuria. *Spleen*: not enlarged. *Temperature*: normal. *Digestive system*: appetite normal; constipation common; vomiting rare but serious. *Mental condition*: unaffected. No tremors.

Note on Clinical Types.—These are closely allied, and any one may follow the others, e.g., 'wet' type in a previous 'dry' beri-beri. Types may coexist, and muscular atrophy and weakness become apparent as œdema improves in 'wet' type.

Prognosis.—Serious in acute cardiac type. With treatment, good in other forms. The peripheral neuritis improves but slowly (as from other causes). Mortality very low if nutritious anti-beri-beri diet available.

Diagnosis.—Simple in a beri-beri country. In non-rice beri-beri, is often unsuspected. Diagnosis from:—

NEPHRITIS.—No albuminuria.

HEART DISEASE (often difficult).—No murmurs. Anæsthesia over *tibiæ*. Occurrence of numerous cases.

ALCOHOLIC NEURITIS.—No nervous or mental disturbances.

MALARIAL NEURITIS (rare).—No fever. No splenomegaly. Rarely from: trichiniasis, ankylostomiasis.

Prophylaxis.—Dietetic: a mixed nutritious diet. If this is not available, the addition of substances rich in the vitamin: yeast, marmite, or undermilled rice.

Treatment.—Bed (to protect heart). Venesection. *Vitamin B₁*: by mouth as yeast, or a fuller's earth preparation; if attack severe, inject daily 500 units. Light diet and yeast. Cardiac stimulants useless.

ATYPICAL FORMS AND CONDITIONS ALLIED TO BERI-BERI.

The discovery of beri-beri 'vitamin' has enabled these to be more properly understood, but many factors still uncertain.

1. Ship Beri-beri.—Onset gradual. Symptoms: (1) *Œdema* of ankles, spreading upwards; (2) Tingling and weakness in legs; (3) Rapid pulse. *No hæmorrhages or spongy gums. No albuminuria.* Neuritis rarely severe, and acute cardiac form rare. On change of diet, recovery rapid. Diet often mixed, and of high nutritional value; defect solely in vitamins, often due to sterilization of food. Became frequent among Norwegian fishermen after 1894, following change by law from a poor but vitamin-rich diet to one superior but vitamin-free. Period of development shorter than rice beri-beri (90 days). Scurvy may coexist. Protein sometimes also deficient, i.e., nutritional œdema (see CAUSES OF ŒDEMA). Œdema in kidney disease.

Beri-beri—Atypical Forms, etc., *continued*.

2. In Asylums, etc.—Similar to ship beri-beri in etiology.

3. Epidemic Dropsy.—Occurs in India (mainly Bengal), also Mauritius and Fiji. Europeans rarely affected.

PATHOGENESIS.—Usually due to an adulteration in mustard oil. Is not beri-beri or due to infected rice.

SYMPTOMS.—Onset rapid. Diarrhoea. Œdema generalized. Erythema progressing to ulcerated areas. Anaemia. Cardiac symptoms. Glaucoma common. No albuminuria. No neuritis. Mortality : low.

CHAPTER LXXII.

PELLAGRA.

A disease of deficiency, due to absence from diet of vitamin B₂, characterized by lesions of the skin, alimentary canal, and nervous system, tending to be chronic, with recurrences in spring.

History and Distribution.—

Italy and Roumania for long formed chief centres. Also common in Mediterranean, and Balkan States.

In United States, recognized about 1907: extensive outbreak occurred subsequently in Southern States, cause uncertain. In British Isles, described first in 1912 (Box and others). Found also in South Africa, Nyasaland, etc. Wide recognition may be due to new occurrences or to better diagnosis. Many cases discovered in asylums.

Etiology.—

AGE.—All ages: mainly 20 to 50 years.

SEX.—In United States females predominate. Otherwise about equal.

CLIMATE.—Mainly in warm climates.

SEASON.—Especially in *spring*: often yearly recurrences.

Poor and rural populations mainly affected.

Pathogenesis.—Is a disease of deficiency, probably due to absence of vitamin B₂ (*see* p. 366). All cereals are poor in B₂; milk, meat, green leaves, potatoes, and roots are rich in B₂. Pellagra occurs mainly in, but is not confined to, populations largely subsisting on maize and essentially on diets poor in meat and milk. In Italy was considered to be due to spoiled maize, but it occurs on other diets, nor is whole maize preventive. Is not due directly to deficiency of proteins, as once asserted. Vitamin A may also be a factor.

Spring recurrences may be due to variations in vitamin in diet.

Morbid Anatomy.—No specific changes.

EMACIATION.—Marked. Bones fragile.

BRAIN.—Meninges thickened, often oedematous.

SPINAL CORD.—Meninges thickened. *Posterior columns degenerated*, and Clarke's column cells degenerated. Most marked in cervical and dorsal regions.

PERIPHERAL NERVES.—Changes rare.

ALIMENTARY CANAL.—Atrophy of mucous membrane. Ulceration common in colon and rectum.

Liver fatty. Kidneys small and fibrotic.

Symptoms.—Affects mainly: (1) Skin; (2) Alimentary canal; (3) Nervous system. 'Dermatitis, diarrhoea, and dementia'. Any one of these systems may be chiefly affected, but nervous system usually latest. Course variable. Onset and progress are usually insidious; development may occupy many years. Progress is occasionally acute.

Spring recrudescences marked: symptoms improving in cool weather, and recurring yearly as summer approaches.

PRODROMAL SYMPTOMS.—Tend to occur 2 to 3 months before eruption. Often overlooked. Vague digestive disturbances: loss of appetite. *Loss of weight*. May be mental depression, insomnia, headache, and vertigo.

EARLIEST STAGES.—Frequently sore tongue and skin lesions.

COURSE.—Variable, often long, period of characteristic symptoms, with remissions and recrudescences. *Anæmia*; may be megalocytic. *Urine*: contains porphyrin; significance unknown.

LATE STAGES.—Cachexia, marasmus, and dementia. Death from cardiac weakness or intercurrent disease.

Alimentary Canal.—

STOMATITIS.—Mucous membrane red and painful: on improvement leaves a smooth tongue. Occasionally ulceration, or membrane. *Salivation* profuse.

DIARRHŒA.—Severe and persistent. Pain variable. Stools not characteristic.

PROGRESSIVE EMACIATION.

Various gastric symptoms: anorexia, nausea, dyspepsia. In later stages, atrophic gastritis with absence of free HCl.

Skin Lesions.—

SEASON.—Occur and recur in spring: abate after summer.

DISTRIBUTION.—(1) *Backs of hands* earliest, and rarely escape; spreads up forearm for varying distance; palm escapes. Other sites less commonly or later affected: *face*, diffuse or butterfly-wing distribution; *neck*; feet; elbows; genitals. Aggravated by sun, but not always confined to exposed areas. (2) *Symmetrical*, always. (3) Sharp line of demarcation common.

ERUPTION.—Commences as *erythema*, closely resembling sunburn. Later, skin becomes swollen, dry, and desquamates, or wet pemphigoid lesions form. After repeated attacks, skin is *pigmented*, dry, and thickened.

Summary.—Symmetrical pigmented dermatitis of backs of hands, forearms, and face, with yearly recurrences.

Pellagra, continued.

Nervous System.—Changes slower than in skin and alimentary canal.

MENTAL CHANGES.—Irritability, melancholia, acute mania; suicide not uncommon. Progress to dementia.

SYMPTOMS OF COMBINED SCLEROSIS OF THE CORD.—

Sensory system: burning pains, formication, girdle pains. *Motor system*: muscular weakness, ataxia, tremors, occasionally convulsions. *Vertigo* common. Knee-jerks variable. Plantar response extensor.

Typhoid Pellagra.—An acute typhoidal condition may occur: usually after several yearly relapses. Mortality high, within one to three weeks.

Pellagra sine Pellagra.—Dermatitis absent. Rare, but apparently authentic.

Prognosis.—In earlier stages, good with treatment. Mortality in Italy about 5 to 10 per cent. Prognosis depends mainly on mental changes: with dementia, improvement slight. *Duration*, often years: death from exhaustion or intercurrent disease. In typhoidal form, mortality high.

Diagnosis.—Simple in fully developed condition in pellagrous countries. Sporadic cases mainly found in asylums. *Skin lesions* differentiate from sprue and scurvy.

Prophylaxis.—Mixed diet containing meat, vegetables, and milk.

Treatment.—Diet as above: also yeast and marmite, one ounce daily. Liver extract: good results.

CHAPTER LXXIII.

INFANTILE SCURVY.

A disease of deficiency occurring in infancy, due to the absence from the diet of vitamin C, and characterized mainly by subperiosteal hæmorrhages and anæmia.

Condition is identical with adult scurvy. Former names 'acute rickets', 'infantile rickets', and 'scurvy rickets' are erroneous: but rickets may coexist.

Anti-scorbutic Vitamin.—See Chapter LXX, p. 367.

Morbid Anatomy.—Increased capillary permeability. Hæmorrhagic and serous effusions between periosteum and bone; also (to less degree) into skin and deeper tissues. May be fractures or separation of epiphyses. Often hæmorrhages into marrow.

HISTOLOGY.—Inhibition of growth of osteoblastic bone. Rarefaction of bone. Irregularity and may be disorganization at sites of bone formation. Swelling and dégeneration of endothelium of capillaries.

Pathogenesis.—Due to deficiency of vitamin C in milk, milk foods, and treated milk. Very rare in breast-fed infants.

Symptoms.—

PERIOD OF DEVELOPMENT.—Usually about age of 8 months. This accords with the period of development of adult scurvy. Infant on diet of proprietary foods or treated milk.

ONSET of severe symptoms often sudden, but previous ill-health. Pale, asthenic, but not wasted.

CHARACTERISTICS.—

1. *Screams when touched or moved.* Extreme tenderness. Lies very still. Both legs often everted. No true paralysis.
2. *Swelling*, usually lower end of femur: indefinite nature. Near but not in joint; extends up shaft; very tender; skin not hot; due to subperiosteal hæmorrhage. Less often, upper end of tibia. Upper extremities rarely.
3. Swelling of gums round teeth less constant than in scurvy. Gums rarely ulcerate. *If no teeth, gums normal.*

Occasionally :—

4. Hæmorrhage into orbit and proptosis. Hæmaturia. Hæmorrhages from mucous membranes and petechiæ uncommon.
5. Fractures, close to epiphyses, or separation of epiphyses.
6. Ecchymoses and tender swellings (serous) in skin and deeper tissues; petechiæ rare. Œdema of face.

Temperature may be normal. Rarely above 102°.

ANÆMIA.—Of hypochromic type; constant, but rarely severe. No characteristic changes: platelets, coagulation time, and bleeding time normal.

RADIOGRAPHS.—Density of bone diminished; characteristic window-like spaces.

MILD DEGREES.—Probably not uncommon. Anæmia said to occur without bleeding.

Diagnosis.—See also VITAMIN C DEFICIENCY, p. 368.

CHARACTERISTICS: (1) Screaming when touched; (2) Indefinite swelling at lower end of femur; (3) Predisposing diet; (4) Rapid cure when treated.

DIAGNOSIS FROM :—

ACUTE OSTEOMYELITIS.—High temperature and severe constitutional symptoms.

RHEUMATIC FEVER.—Very rare under two years and never under one year.

HÆMORRHAGIC DIATHESIS.—Hæmorrhage from mucous membranes.

INFANTILE PARALYSIS.—No swelling.

ULCERATIVE STOMATITIS.—Scurvy only affects gums.

SYPHILITIC EPIPHYSITIS.—Usually under 3 months.

Occasionally from: trauma, acute leukæmia, chloroma, sarcoma of skull, renal sarcoma.

Prophylaxis.—Antiscorbutic supplement essential for all infants artificially fed, and advisable for those breast-fed: one to four teaspoonfuls of orange juice daily.

Infantile Scurvy, *continued*.

Prognosis.—Should be well in one week.

Treatment.—Disease yields rapidly to antiscorbutic substances: juice of one orange daily; ascorbic acid tablets, 5 mgm. daily.

ANÆMIA.—Rapid regeneration with reticulocytosis results with above treatment: iron useless; may react to liver (contains vitamin C).

LOCAL TREATMENT.—Wrap limbs in cotton-wool. Cage to keep off weight of bed-clothes.

CHAPTER LXXIV.

SCURVY.

(*Scorbutus*.)

A disease of deficiency due to the absence from the diet of vitamin C, and characterized by swelling of the gums, by hæmorrhages into the skin and subcutaneous tissues and from mucous membranes, and by anæmia.

Identical with infantile scurvy.

Anti-scorbutic Vitamin.—See p. 367.

Morbid Anatomy.—Changes mainly due to hæmorrhages and serous effusions into skin, deeper tissues, or subperiosteum.

Symptoms.—

PERIOD OF DEVELOPMENT.—At least 4 months on scurvy diet: more commonly, nearly 8 months.

ONSET.—Insidious: general weakness, pallor, then symptoms of anæmia. Bruises very easily.

CHARACTERISTICS.—

1. **SWELLING OF GUMS.**—Becomes extreme. Gums bleed easily; foetor; teeth fall out. (Rarely, gums unaffected.)

2. **HÆMORRHAGES.**—(i) Hæmorrhages from mucous membranes, nose and mouth, and subconjunctival; *but hæmoptysis and hæmatemesis rare*. (ii) Serous effusions or ecchymoses into skin and subcutaneous tissues, also intramuscular tissues or under periosteum; common in loose folds of skin. Result from slight bruises. Petechiæ rare. (iii) Deep hæmorrhages, often large, tender, pit on pressure; skin on surface red and hot. *Ulceration common*.

3. **ANÆMIA.**—Palpitations often severe. Some oedema of the ankles, but no general anasarca. Blood: secondary anæmia. (See INFANTILE SCURVY, p. 378.)

Albuminuria usual. Temperature normal, unless complications. Constipation most frequent, but diarrhoea not uncommon. Alimentary system unaffected except anorexia from condition of gums.

Complications.—

GANGRENE OF LUNGS.—From septic inhalation, or from hæmorrhages in lungs.

NIGHT BLINDNESS.—Frequently associated. Relation doubtful.

BERI-BERI.—May coexist: usually preceding scurvy.

Diagnosis.—Simple when many cases. In sporadic cases, from:

(1) Acute leukaemia, myeloid or lymphoid: blood examination.

(2) Hæmorrhagic diathesis: gums unaffected. Rarely, when gums unaffected, from various purpuric affections: by reaction to treatment.

Prognosis.—Death from cardiac failure, or intercurrent disease, e.g., diarrhœa. Reacts readily to treatment: deformities from hæmorrhages may be permanent.

Prophylaxis and Treatment.—Antiscorbutic substances. Concentrated lemon juice preventive. All drugs useless. In severe stages, juice of fresh oranges or lemons most effective: at least 3 daily. Ascorbic acid by mouth or intravenously (40 to 100 mg. daily).

FOR THE MOUTH.—Hydrogen peroxide washes.

Mild Scurvy.—Partial vitamin C deficiency may be not uncommon—e.g., in infants, or in peptic ulcer diets (Graham). *Vitamin C deficiency* can be estimated by: (1) Göthlin's test for capillary permeability: arm compressed for 15 minutes at 70 mm. Hg, petechial hæmorrhages result. (2) Estimation of vitamin C saturation (see VITAMIN C, p. 368).

CHAPTER LXXV.

RICKETS.

(*Rachitis*.)

A disease of deficiency, due to absence from the diet of vitamin D, occurring in late infancy, characterized mainly by changes in the bones and tendency to catarrh of mucous membranes.

Etiology.—

AGE.—Most commonly observed at one or two years: rare under six months and over three years. Very rare in breast-fed infants.

VITAMIN D DEFICIENCY.—May be due to: (1) Absence of or over-prolonged breast feeding; (2) Absence of sunlight—occurs especially in cities and temperate zones, in winter and spring; (3) Deficiencies in diet; (4) Osteomalacia in mother.

Sexes equal. Heredity absent. Syphilis aggravates, but does not originate.

Pathogenesis: Relation to Vitamin D and Calcium.—Rickets is principally due to deficiency of vitamin D, which is necessary for normal bone formation.

Rickets—Pathogenesis, continued.

1. Rickets is curable and preventable by: (a) Diet rich in vitamin D; (b) Exposure to sunlight or irradiation (Huldschinsky, 1919)—due to formation of vitamin D from ergosterol in skin.
2. INFLUENCE OF CEREALS.—The more cereal the diet contains, the more vitamin D is required. Partly due to greater growth, but possibly also a toxic substance present in cereals, especially oatmeal, inhibiting D ('toxamin'). A given amount of D may prevent rickets in an undergrown child but be insufficient when growth commences—e.g., rickets developing during recovery from coeliac disease. Per contra, starvation may heal rickets.
3. INFLUENCE OF CALCIUM AND PHOSPHORUS.—Sufficient supply is obviously essential for correct bone formation: amount in milk is near required minimum. (a) Rickets does not develop, even in absence of vitamin D, if ratio of calcium and phosphorus in diet is kept at optimum level. (b) Rickets develops, in deficiency of vitamin D, if there is deficiency either of calcium or phosphorus, or if there is disproportion between their amounts in diet: the greater the disproportion the more vitamin D is necessary. (c) If rickets is present, increased administration of calcium results only in increased excretion without beneficial effect. (d) 'Low-calcium' rickets: if calcium in diet is deficient, also vitamin D, then serum-calcium falls and tetany is common. (e) Deficiency of calcium with adequate vitamin D causes osteoporosis and not rickets. (See also VITAMIN D, p. 369.)

Calcium and Phosphorus Metabolism.—(See also DISEASES OF THE PARATHYROID GLANDS—CALCIUM AND PHOSPHORUS METABOLISM.)
BLOOD.—Essential abnormality is low inorganic plasma phosphorus (2 mgm. instead of 5 mgm. per cent). Serum calcium often about normal (10 mgm. per cent), but may be low (tetany then common).

EXCRETION.—Both increased in faeces. No definite change in urine.

PHOSPHATASE.—Increased in blood. (Is active enzyme in deposition of calcium phosphate in bone.)

Morbid Anatomy of Bones.

DEVELOPMENT OF NORMAL BONE.—(A) *Intracartilaginous or endochondral ossification* (epiphyses): Characterized by orderliness, and by confinement and completion of each process in a definite zone. Zones are: (i) *Normal cartilage*. Blood-vessels absent or very scanty. (ii) *Zone of proliferation of cartilage*. Cartilage cells enlarge, multiply, and become arranged in parallel columns. Blue tint. (iii) *Zone of primary or provisional calcification*. Matrix becomes calcified between columns of cartilage cells. Forms a yellow line of not greater breadth than $\frac{1}{8}$ inch. (iv) *Region of ossification*. Capillary loops end on sharp line just short of previous zone. Processes occurring on the walls of the spaces containing the loops are: (a) Large osteoclasts absorb the calcified matrix; then (b) Osteoblasts deposit ('apposition') osteoid tissue in the remnants of matrix; (c) This becomes

true bone on deposition of calcium phosphate (*see* CALCIUM AND PHOSPHORUS METABOLISM—PHOSPHATASES). By this method, bones increase in length. In adult life bone is continually renewed by similar means. (B) *Intrameubranous ossification or subperiosteal bone formation*: By growth of capillary loops, and by osteoblasts depositing bone in connective tissue below periosteum. Bones thus increase in width.

In rickets, essential change is deficient calcification of osteoid tissue. Zone of primary calcification also affected. Bone development is thus characterized by:—

1. *Multiplication of cartilage cells excessive* and no arrangement in columns: a broad blue area results. Hence *enlargement of epiphyses*.
2. *Primary calcification deficient*.
3. *Excessive vascularity*. Capillary loops invade zones of calcification, proliferation, and even normal cartilage.
4. *Formation of true bone defective*: (a) Osteoclasts absorb too much irregularly calcified matrix; and (b) Osteoid tissue is not properly calcified. Hence *softness of bone*.

A transverse section through epiphysis will thus show in a single field—irregular proliferated cartilage cells, attempts at column formations, areas of partial and irregular calcification, capillary loops, areas of osteoid tissue, and maybe areas of fully formed true bone.

PERIOSTEUM.—Vascular layer much thicker than normal: also distribution irregular. Increases size of epiphyses.

CHANGES IN THE BONE-MARROW.—Red cells very numerous. Myelocytes diminished.

LIME SALTS IN RICKETY BONES.—From 20 to 50 per cent of weight, compared to 60 to 65 in normal bone. *As rickety condition improves*, deposit of lime salts may become excessive, possibly from great vascularity; hence bone finally is harder and more brittle than normal, and, if recovery has been too rapid, deformities become permanent.

PARATHYROID GLANDS.—No recorded changes.

Radiographic Appearances.—

WRIST shows earliest appearances recognizable in radiograms: (1) End of ulna fuzzy; (2) End of radius widened; (3) Signs of osteoporosis.

FULLY DEVELOPED APPEARANCES.—(1) Zone of proliferation increased in width and ill-defined; (2) Epiphyses and diaphyses show irregular growth and ossification; (3) Medullary cavity increased in width and translucency.

RECOVERY.—Shown by: bone shadow denser; epiphyses more distinct.

FINAL CURE.—Characteristic *thin white line* where new calcification commences.

Symptoms.—Rickets is a disease of nutrition, of which the bone changes are only one, though the most important, manifestation. Aggravations occur in winter and spring.

Rickets—Symptoms, *continued*.

GENERAL DESCRIPTION.—Onset insidious. (i) Age, most commonly in second year; (ii) Diet deficient in fat; (iii) Child plump but flabby, irritable; (iv) Delay in sitting up and walking; or 'goes off his legs'; (v) Profuse sweats; (vi) Dentition delayed; (vii) Tendency to bronchitis, diarrhoea, and, in severe cases, convulsions. *On examination:* (i) Head large, anterior fontanelle patent, frontal bossing; (ii) 'Rickety rosary', pigeon breast, and Harrison's sulcus; (iii) Epiphyses enlarged; (iv) Deformities of long bones; (v) 'Pot-belly' and palpable liver; (vi) Laxity of ligaments.

PRINCIPAL SYMPTOMS.—

GENERAL NUTRITION.—Often fat, but flabby. In severe forms, wasting. Irritable. Poor appetite.

SWEATING.—Early and constant. Especially at night and of head.

BRONCHITIS.—Common, also bronchopneumonia; serious.

ALIMENTARY SYSTEM.—(1) Abdomen distended, 'pot-bellied' flatulence, muscular relaxation, and descent and enlargement of liver; (2) Enteritis and intestinal disturbances common; (3) Liver frequently palpable, spleen less often: due to displacement more than enlargement.

DENTITION DELAYED.—Very constant. Often no teeth at 12 months. Caries early.

BONES AND LIGAMENTS.—*See below.*

NERVOUS SYSTEM.—Convulsions: rickets is a very common cause. Laryngismus stridulus and tetany: usually associated with rickets. *No mental changes.*

TEMPERATURE.—Normal, unless complications.

BLOOD.—Variable degree of anæmia.

Changes in the Bones and Ligaments.—

THORAX.—*Beading of the ribs* or 'rickety rosary', enlarged epiphyses at costochondral junction, most constant and often earliest symptom of rickets. Subsequently diminishes, rarely recognizable at puberty. *Pigeon breast:* sternum projects, especially lower half, section through thorax becomes triangular, costochondral junction sunk. *Harrison's sulcus:* groove from ensiform cartilage outwards, with costal margin curved upwards. (These latter two changes also occur in conditions with inspiratory obstruction, e.g., enlarged tonsils.)

EPIPHYSES.—Enlarged. Especially lower end of *radius*, and frequently of tibia and femur.

HEAD.—

1. *Enlarged*, square and flattened on vertex ('caput quadratum'). Less commonly, lengthened antero-posteriorly.
2. *Anterior fontanelle patent* until 2 or 3 years (normally closed at $1\frac{1}{2}$ years).
3. Bossing of frontal eminences: 'hot-cross bun' head.
4. *Craniotabes.* Not common. When present, frequently, but not always, coexistent syphilis.

CURVATURE OF LIMBS AND DEFORMITIES.—The long bones, being soft, bend from weight of body and muscular traction.

TIBIA.—(i) *Commonest deformity*: Curve at lower third, concavity on external surface; or a sharp forward bend. (ii) Curve at upper third, concavity on internal surface, viz., 'bow legs'.

FEMUR.—Less common. (i) General antero-posterior curve. Rarely: (ii) Coxa vara. (iii) Genu valgum.

SPINE.—Kyphosis, if child sits up.

OTHER DEFORMITIES AND RESULTS.—

Upper extremity: curvatures uncommon, unless child crawls on arms.

Pelvis: flattened antero-posteriorly, may be small and contracted: important in females.

Permanent dwarfing: may result from deformities and disease of epiphyses.

Fractures, common, especially 'green-stick'.

LIGAMENTS.—*Extreme laxity*. This and muscular weakness aid deformities.

MUSCLES.—May be great weakness, even suggesting paralyses.

Course and Prognosis.—Rickets reacts readily to correct treatment. Recrudescence very rare.

MORTALITY.—Results mainly from complications of *bronchitis and diarrhoea*. Rarely from convulsions, laryngismus stridulus, and tetany. Direct mortality very slight.

DEFORMITIES.—Improve, and if slight may disappear with rest, treatment, and in subsequent growth. If severe, many persist, e.g., *rickety pelvis*, 'bow-legs'.

BONES.—Subsequently harder than normal, and more brittle.

COMPLICATIONS.—(i) Respiratory, (ii) Alimentary disturbances, (iii) Tetany—rare but serious (*see TETANY*). Syphilis increase severity of rickets. In splenic anæmia of infants, rickets often present.

Diagnosis.—In mild types, difficult; in severe, simple. *Diagnosis* occasionally must be made from: (1) Infantile paralysis: sudden onset, reflexes absent. (2) Spinal caries: sharp local curve. (3) Hydrocephalus. (4) Congenital syphilis: Wassermann reaction positive.

Prophylaxis.—

BREAST FEEDING.—8 to 9 months. Rickets subsequently rare.

ALL INFANTS need supply of vitamin D in addition to ordinary nourishment. Give cod-liver oil, ℥5 at 1 month, ℥30 at 3 months, t.d.s., or irradiated ergosterol, or sunlight or ultra-violet light radiation. Yolk of egg valuable.

IN SECOND YEAR OF LIFE, give 1½ to 2 pints of milk daily.

DIET OF MOTHER, in pregnancy and lactation, must be properly balanced.

Rickets, *continued*.

Treatment.—

SUPPLY OF VITAMIN D.—As above. (Avoid overdosage: if progress rapid, bones overharden and also fix in positions of deformity.)

DIET.—Milk ($1\frac{1}{2}$ to 2 pints), rusks, yolk of egg, orange juice, with fish, etc., according to age.

REST.—To prevent and correct deformities. Especially if fat. Massage. If severe, 3 months' complete rest: in open air. Long splints beyond feet will successfully prevent child from walking.

ANÆMIA.—May need iron. Treat complications. Calcium salts valueless.

DEFORMITIES.—May need operative treatment later.

Antenatal Rickets.—May occur in children of osteomalacic mothers. Former 'fœtal rickets' included cretinism, achondroplasia, and osteogenesis imperfecta

LATE OR ADOLESCENT RICKETS.

Ordinary rickets commences before 3 years of age. From 3 years and up to the age of 14 or 15 years conditions occasionally arise in which changes at epiphyses and development of bony deformities more or less closely resemble rickets. There are several groups, all rare, at least in advanced degree. Certain, but not all, are fairly directly connected with deficient fat, either in diet or by absorption, and ascribable to vitamin D becoming deficient in relation to amount of growth. Some cases diagnosed as Still's disease probably belong here. Syphilis is certainly not a usual factor.

Provisional Groups.—

1. **LATE RICKETS.**—Occurs in later years of childhood under conditions in which rickets and osteomalacia develop. Long bones only affected obviously. Identical with rickets in pathogenesis, histology, and blood chemistry. Subjects occasionally but not necessarily have had rickets previously ('recrudescant rickets'). Treat as rickets.
2. **CÆLIAC RICKETS.**—(See CÆLIAC DISEASE.)
3. **RENAL RICKETS.**—(See RENAL INFANTILISM.)
4. **DEFICIENCY OF FAT IN DIET.**—Recorded as result of war conditions.
5. **WITH BLOOD CHANGES AND SPLENIC ENLARGEMENT.**

CHAPTER LXXVI.

OSTEOMALACIA.

A disease of deficiency occurring in adult life, characterized pathologically by deficient calcification of bone, the softening resulting in bending, deformities, and liability to fractures.

Due to deficiency in diet of vitamin D, and also of calcium salts. Is essentially identical with rickets of 'low-calcium' type.

Etiology.—

ECONOMIC FACTORS RESPONSIBLE.—

1. Diet ill-balanced : deficient in vitamin D and calcium salts ; often excess of acid-forming elements.
2. Lack of sunlight. In India from purdah system ; in China, from confinement by former bandaging of girls' feet.
3. In India, pregnant women are kept short of food (to get small, easy foetus). Also lactation prolonged, may be 4 years.

GEOGRAPHICAL DISTRIBUTION.—Endemic in North India, North China, and Japan. Foci on Rhine and in Switzerland. Very rare in British Isles and America.

SEX.—Females predominate (92 per cent) : specially associated with *pregnancy and lactation* : attacks occur earlier and severer in each successive pregnancy.

Never congenital. No hereditary factor (but infants often rickety).

Morbid Anatomy.—

BONES.—Essential change is deficient calcification of osteoid tissue, generalized through skeleton : resembles rickets. Bone is soft, rather fragile ; hence bending commoner than fractures, but both occur. Very light : may float.

HISTOLOGICAL CHANGES.—

1. *Compact Bone.*—(i) Haversian canals dilated. (ii) Adjacent substance free of lime salts. (iii) In still calcified tissue, osteoclasts are large, irregular in shape, and crowded together, suggesting resorption of bone. Structure of lamellæ obscured.
2. *Medullary Cavity.*—Trabeculæ thin ; little calcified bone ; much osteoid tissue, some apparently newly formed by the numerous osteoblasts present.

Bone-marrow very vascular : hæmorrhages and cysts common.

PARATHYROID GLANDS.—Often hypertrophied. Cause obscure (? compensatory).

OVARIES.—No change.

RENAL CALCULI.—Common.

Calcium and Phosphorus Metabolism.—

BLOOD.—Serum calcium and inorganic plasma phosphorus both low. Phosphatase increased.

EXCRETION.—Calcium and phosphorus both increased in fæces.

Pathogenesis.—As in RICKETS (p. 379), modified by adult age (with cessation of endochondral ossification) and special circumstances. Pregnancy and lactation cause additional drain of calcium and phosphorus for use of child : hence improvement after parturition. Aggravation in winter and spring as in rickets.

Symptoms.—

ONSET with aching pains, especially back and thigh, general weakness. Then bending of legs, and waddling gait. On examination, deformities present.

Osteomalacia—Symptoms, *continued*.

WHEN DEVELOPED.—Often much deformity. Main changes:—

1. **PELVIS.**—Sacrum pushed forward by weight of body, and acetabula inwards by the femurs; symphysis pubis protrudes like a beak. General 'clover-leaf' shape, and great narrowing of the pelvis. Interferes with parturition.
2. **SPINE.**—Curvature often extreme.
3. **Bending of long bones, sternum, ribs.** Coxa vara. Fractures may occur.

URINE.—Increase of calcium phosphate reported, and occurrence of renal calculi.

TETANY.—In severe forms. (*See TETANY.*)

RENAL CALCULI.—Occasionally.

RADIOGRAPHS.—Bones rarefied.

Diagnosis.—By changes in pelvis, radiographs, and blood chemistry.

Progress.—Variable in absence of treatment. May progress only in pregnancy. Some advance, with death in one to ten years, from exhaustion or tetany. Cured by appropriate treatment (deformities permanent).

Treatment and Prophylaxis.—As for rickets, and with calcium-rich diet or calcium administration (especially in pregnancy). Ovariectomy unnecessary. Cæsarean section may be unavoidable. (*See also TETANY—TREATMENT.*)

Section V.—DISEASES OF THE DIGESTIVE SYSTEM.

CHAPTER LXXVII.

DISEASES OF THE MOUTH.

I. STOMATITIS.*

Clinical Groups.—(1) Acute. (2) Aphthous. (3) Ulcerative. (4) Parasitic: thrush. (5) Gangrenous: cancrum oris, noma. (6) Mercurial: ptyalism. (7) Vincent's angina. (8) Other forms.

Acute Stomatitis (*Simple or Catarrhal Stomatitis*).—

OCCURRENCE.—Frequent at all ages. Usually both general and local predisposing causes together: (1) General: debility, gastrointestinal disturbance, specific fevers. (2) Local: in children, dentition; in adults, tobacco, carious teeth, and spiced foods.

SIGNS.—Mucous membrane in mouth dry and red: tongue becomes swollen, furred, and indented.

SYMPTOMS.—Discomfort, especially on mastication.

TREATMENT.—

GENERAL.—Treat general condition, especially bowels.

LOCAL.—Sponge after each feed, or wash mouth with hydrogen peroxide, or tincture of myrrh and borax. If obstinate, apply dilute silver nitrate (gr. iij to ounce).

INTERNALLY.—Pot. chlorate gr. ij to v, t.d.s., for child.

Aphthous Stomatitis (*Follicular or Vesicular Stomatitis*).—

OCCURRENCE.—In children, under 3 years, poorly nourished, especially after fevers or gastric trouble.

SIGNS.—Multiple small ulcers with gray bases over inner side of lips, cheeks, and edges of tongue: in severer cases also on pharynx. Commence as vesicles; ulceration rapid, usually within 24 hours.

SYMPTOMS.—Mastication painful: increased salivation: breath heavy: some constitutional disturbance.

TREATMENT.—See ACUTE STOMATITIS.

Touch, if possible, each ulcer with silver nitrate stick.

No special parasite associated. Heals rapidly.

Ulcerative Stomatitis.—

OCCURRENCE.—Children, after first dentition. Also epidemically in institutions. Predisposed to by malnutrition, and locally by irritation.

* See also DISEASES OF THE SALIVARY GLANDS, p. 392.

Ulcerative Stomatitis, continued.

SIGNS.—Commences at margin of gums: swelling, redness, bleeding, and then ulceration. Lips, cheeks, tongue swollen, but rarely ulcerated. Teeth may loosen, and rarely jaw necroses. Submaxillary glands enlarged. Salivation increased. Breath foul.

SYMPTOMS.—Mastication painful. Severe constitutional symptoms.

TREATMENT.—Potassium chlorate: very efficient. As mouth-wash (gr. x to ʒj): also internally gr. ij to v, t.d.s., child, or gr. v to x, t.d.s., adult. If severe, give anæsthetic and clean gums gently. General treatment.

Generally due to spirochætes.

Parasitic Stomatitis: Thrush.

OCCURRENCE.—Mainly in bottle-fed infants, but also in debilitated adults. Predisposed to by local uncleanness.

PARASITE.—A fungus, *Oidium albicans*, or more correctly, *Saccharomyces albicans*—a yeast, with branching filaments and ovoid torulæ.

SIGNS.—Commences on tongue as dead white spots; entire buccal cavity may be covered by dry grayish membrane; grows among superficial epithelial cells, and scrapes off readily.

DIAGNOSIS from aphthous stomatitis, by absence of ulcers, dryness, presence of membrane, and microscopic examination.

TREATMENT.—Often very resistant.

GENERAL.—Of great importance. Dose of castor oil. Clean bottles or teats.

LOCAL.—Apply gently glycerin and borax, or sodium sulphite (ʒj to ʒij water), or sulphurous acid (diluted six times).

Gangrenous Stomatitis: Cancrum Oris: Noma.—Rapidly progressing infective gangrene. Rare. Pathogenesis doubtful: may be Vincent's organisms.

OCCURRENCE.—In children, following acute fevers, especially measles: generally debilitated subjects. Also in agranulocytosis.

SIGNS AND SYMPTOMS.—Commences as sloughing ulcer usually on inner side of cheek; induration and gangrene proceed rapidly; cheek usually perforates; may involve bone. Constitutional symptoms very severe. Later, apyrexia and extreme toxæmia, accounting for absence of pain. Death almost invariable, 4 to 7 days.

TREATMENT.—Only effective treatment is widespread resection of tissues, and strong antiseptic. Insidious onset generally results in most cases being inoperable on first observation.

Mercurial Stomatitis: Ptyalism.—In susceptible persons, may follow very small doses.

SYMPTOMS.—Earliest, usually tenderness on biting. Salivation excessive; gums spongy; tongue swollen; breath foul; salivary glands enlarged; teeth may feel loose. In severe cases teeth drop out, and jaw necroses: rarely seen.

TREATMENT.—Stop mercury; open bowels; give alkaline drinks; liquid diet. Alkaline mouth-wash.

Internally, potassium iodide said to be effective.

Recovery usually rapid.

Vincent's Angina.—An inflammatory condition of the fauces and mucous membrane of the mouth. Occurs at all ages, especially with pyorrhœa, syphilis, and other affections of the mouth. Is feebly infectious by direct contact.

PATHOLOGY.—Two organisms present: (1) Vincent's spirillum: thin, two or more loose spirals: resembles *S. refringens*. (2) Fusiform bacilli: long tapering bacilli: Gram-negative: preferential anaerobe: possibly a stage of the spirillum (unproved).

NOTE.—These organisms may be present in normal mouth: possibly produce lesions only in presence of another factor, e.g., debility. Some authorities believe that agranulocytosis and other blood changes can be produced by Vincent infections, but evidence is inconclusive.

SYMPTOMS.—Vincent described two types: (1) Membranous or diphtheroid: adherent membrane, usually on tonsils but also on neighbouring structures: bacilli only present. (2) Ulcerative: small ulcers with broken-down membrane: bacilli and spirilla present.

Distinction of types generally indefinite. Inflammation usually involves, in addition to fauces, gums and mucous membrane of mouth; gums swollen and red, often small ulcers near line of teeth, bleed readily.

Onset usually sudden. Mouth sore, general malaise, headache, prostration, and irritability; pyrexia, usually moderate, may be absent. Cervical and submaxillary glands enlarged and tender: suppuration extremely rare.

DURATION.—From a few days to two weeks. Occasionally becomes chronic.

COMPLICATIONS.—Many described: not common, but may be severe, e.g., otitis media, necrosis of tonsils or jaw.

DIAGNOSIS.—Difficult, if disease limited to fauces, especially from diphtheria and syphilis. Often depends on examination of smears. Wassermann reaction rarely is transiently positive.

TREATMENT.—Swab carefully, and wash mouth frequently with hydrogen peroxide solution. Local cleanliness essential: clean, but do not remove, teeth. One injection of salvarsan compounds is usually rapidly curative.

Follicular Stomatitis.—Small ulcers form on lips, cheek, and tongue. Common as 'sore mouth' in nursing women.

TREATMENT.—Tonics, diet; glycerin and borax locally, sores heal readily. In some persons recurrent attacks throughout life without cause; very resistant to treatment.

Other Forms of Stomatitis.—

BEDNAR'S APHTHÆ.—Ulcers on hard palate of infants. Due to injury by artificial nipple or finger.

PIGMENTATION.—Occurs in Addison's disease.

MANY SKIN DISEASES, herpes, pemphigus, etc., may attack the buccal mucous membrane.

Stomatitis, continued.

ACUTE LEUKÆMIA.—The formation of a semi-acute localized sloughing area on the mucous membrane of the cheek is not uncommon and may be the earliest symptom. The blood should always be examined in such a condition, even if no spleen or glands are palpable. No surgical operation has any good effect.

Pyorrhœa Alveolaris (*Rigg's Disease; Chronic Periodontitis*).—May develop independently or from advance of marginal gingivitis. Attachment of muco-periosteum to root of tooth is destroyed: may or may not be pocket of pus. Rarefying osteitis of alveolar margin follows. No specific causal organisms.

SYMPTOMS.—Halitosis or none; numerous sequelæ have been claimed.

TREATMENT.—By dental surgeon: extensive extraction only after careful consideration.

II. DISEASES OF THE TONGUE.

Apart from conditions noted under stomatitis, the following are important:—

Acute Glossitis.—Follows abrasions from sharp teeth and other causes; burns; also in specific fevers.

SYMPTOMS.—Tongue swollen and painful: pain may radiate to ears. Salivation profuse. Temperature may be high and prostration severe.

PROGRESS AND TREATMENT.—Mild cases resolve with simple measures. Severe cases may progress to Ludwig's angina and œdema of pharynx and larynx: incision of tongue and surgical treatment may be necessary.

Chronic Glossitis.—Due to irritation of tongue from sharp teeth; smoking; chronic alcoholism, syphilis, chronic dyspepsia.

SYMPTOMS.—Tongue sore; red smooth patches.

TREATMENT.—Remove and avoid irritants.

Geographical Tongue (*Eczema, Erythema, Pityriasis of the Tongue: Wandering Rash*).—

Desquamation of superficial epithelium, starting from a spot and spreading in a ring: central parts heal while periphery widens. Fusion of various rings results in 'geographical' outline. Fungiform papillæ may remain prominent. May wander round tongue for months.

ETIOLOGY.—Unknown. No bacterium found. No relation to syphilis: important to avoid error of diagnosis.

OCCURRENCE.—In infants, children, and also in adults: usually with gastric troubles: often transient, but tends to relapse.

SYMPTOMS.—Often none. May itch, and in adults cause fear of cancer.

TREATMENT.—None of effect. Mild mouth-washes.

Leucoplakia Buccalis (*Leukokeratosis: Tylosis Linguae*).—White patches on the tongue due to thickening of superficial layers of epithelium. Patches either smooth or fissured.

ETIOLOGY.—Nearly always, if not always, syphilitic, with local factor, e.g., carious teeth, excessive smoking.

OCCURRENCE.—(1) Small raised white spots. (2) Diffuse, patchy, bluish-white thickening of epithelium: common type. (3) Diffuse throughout buccal cavity: rare. No symptoms.

May become epitheliomatous at any stage; shown by ulceration, induration, or nodules. May disappear spontaneously.

TREATMENT.—Very obstinate. Anti-syphilitic remedies useless. Avoid all irritants. Try X rays. Active local treatment is inadvisable.

Black Tongue (*Hairy Tongue: Melanoglossia*).—Black patch on centre of dorsum: due to prolongation of filiform papillae; nature and origin of pigment unknown; not invariably black. May simulate hairs. No bacterium found. Treatment useless. Returns if scraped off. Disappears spontaneously.

Ulceration of the Tongue.—Causes: (1) Trauma, e.g., sharp tooth. (2) Stomatitis; ulcerative, aphthous; nursing women. (3) Syphilis. (4) Neoplasm. (5) Tuberculosis. (6) Herpes. (7) 'Dyspeptic', if all other forms excluded.

III. FŒTOR ORIS.

(*Foul Breath. Halitosis.*)

Causes.—Numerous:—

MOUTH.—(1) Pyorrhœa alveolaris; (2) Decayed teeth; (3) Chronic lacunar tonsillitis (test by rubbing tonsil with finger); (4) Any form of stomatitis. Usual causes of fœtor.

RESPIRATORY TRACT.—Numerous, e.g.:—

NOSE.—Atrophic rhinitis, ozæna, suppuration in sinuses.

LUNGS.—Bronchiectasis. Also excretions, e.g., acetone.

INDIGESTION.—Breath 'heavy', mainly due to condition of mouth.

Tobacco, onions, garlic, and certain drugs may affect breath.

IV. THE TONGUE IN DISEASE.

The tongue in health is firm, red, moist, with slight fur posteriorly, in front of the circumvallate papillae. Changes in ill-health depend in the main on diminution of buccal secretions, occurring chiefly in: (1) Gastro-intestinal disturbance; (2) Pyrexia; (3) Local conditions, e.g., mouth-breathing. Also in (4) Sore tongue: occurs in pernicious anæmia, sprue, and certain other megalocytic anæmias; also in mercury poisoning and all ulcerations.

Principal changes are: (a) Presence of fur; (b) Dryness.

PRESENCE OF FUR.—Fur is formed by matter accumulating on the filiform papillae. Forms normally during sleep: especially posteriorly, being untouched by roof of mouth in rest.

The Tongue in Disease—Presence of Fur, *continued*.

Fur does not form in infants owing to absence of filiform papillæ.

Furring occurs mainly with gastric catarrh: is not produced by conditions below the stomach, e.g., colitis, dysentery, intestinal obstruction.

DRYNESS OF TONGUE.—In severe toxæmia especially. Due to diminished saliva, and to mouth-breathing from muscular weakness; seen in acute septicæmia, acute peritonitis, etc. If tongue has been furred previously, it becomes dry, brown, and shaggy. In very acute cases where no furring has previously occurred, tongue is dry, brown, and glazed. A similar tongue occurs also in cholera, and in severe diabetes—but usual diabetic tongue is large and red ('raw beef tongue').

Enlarged papillæ may be prominent in children: especially in scarlet fever.

The tongue varies in different individuals. A chronic furred tongue appears compatible with good health. A clean tongue is certainly not proof of normal gastro-intestinal functions: is especially clean with hyperchlorhydria.

CHAPTER LXXVIII.**DISEASES OF THE SALIVARY GLANDS.****I. PTYALISM OR SALIVATION: HYPERSECRETION.**

'Salivation' is applied to an amount of saliva which causes escape from the mouth, or needs special effort to swallow: total amount not necessarily increased. Normal daily quantity 2 to 3 pints.

Causes.—

1. Reflex from stomach (through vagus to salivary centre in medulla): in gastric disturbances, acidity high or low; before vomiting.
2. Local causes: (a) Amount increased (reflex)—e.g., dentition, stomatitis, tic douloureux; (b) Difficulty in swallowing—e.g., laryngitis.
3. Nervous affections: paralysis agitans, post-encephalitic Parkinsonism; occasionally tabes. Difficulty in swallowing: bulbar paralysis, myasthenia gravis, rabies.
4. Hysterical and functional (*ptyalorrhæa*).
5. Pregnancy, early months. Menstruation occasionally.
6. Drugs: iodides, mercury, pilocarpine.

Treatment.—Treat cause. Belladonna. Sedatives. X-ray to salivary glands. Aerophagy may require treatment.

II. XEROSTOMIA OR DRY MOUTH: HYPOSECRETION.

Suppression of secretion of salivary glands.

Causes.

1. Old age: from atrophy of glands.
2. Emotion.
3. Excessive loss of fluid, e.g., diarrhoea.
4. Drugs: belladonna.
5. Diseases of salivary glands, e.g., mumps.

Treatment.—Acids, e.g. lemon, to suck. Cleanse mouth carefully.

III. PAROTITIS.

Specific Parotitis.—See MUMPS, p. 267.

Acute Infective Parotitis or Parotid Bubo.—Occurs with dryness of mouth and absence of mastication. Usually in severe infectious fevers and starvation, as for hæmatemeses. Now rare.

SYMPTOMS.—Gland enlarged and tender, usually bilateral; orifice of Stenson's duct red. Suppuration in severe case.

TREATMENT.—Prophylaxis. Incise if suppuration.

IV. ENLARGEMENT OF THE SALIVARY GLANDS.

Recurrent Swelling of the Salivary Glands.—

1. NON-INFECTIVE TYPE.—

ONSET.—Occurs at all ages. In children: may be associated with asthma and other allergic manifestations. In adults: mainly females with nervous instability.

SYMPTOMS.—Submaxillary or parotid glands affected; bilateral. Enlarge with great rapidity; excited by food, especially acids. Painful only from tension. Duration: usually short, half hour or more.

SALIVA.—Clear; sterile; may be eosinophils; also mucus plugs.

SIALOGRAPH (with lipiodol).—Normal, or larger ducts dilated.

TREATMENT.—Inject adrenalin subcutaneously. Massage glands in intervals.

2. INFECTIVE TYPE.—Mainly in adults. May be due to infection complicating previous type.

SYMPTOMS.—Swelling as above. Subsidence may be incomplete. Tenderness variable.

SALIVA.—Last portions contain pus and bacteria, e.g., streptococci. Unpleasant taste.

SIALOGRAPH.—Terminal acini dilated ('bronchiectasis').

TREATMENT.—Keep glands empty by frequent massage.

Chronic Enlargement of Salivary Glands.—May occur in chronic ptyalism, calculi, syphilis. From certain drugs, e.g., iodides, mercury. Rare sequel of mumps.

Gaseous Tumours of Stenson's Duct and Salivary Glands.—Occur in musicians and glass-blowers.

Diseases of the Salivary Glands, *continued*.

V. UVEO-PAROTITIS.

(*Heerfordt's Disease.*)

A condition characterized by bilateral uveitis and parotitis, often with facial paralysis, with tendency to spontaneous recovery.

Characteristics.—Order of onset varies :—

1. ENLARGEMENT OF PAROTID GLANDS.—Bilateral, firm, may be nodular ; painless. Sialograph normal. Saliva sterile. Submaxillary and lachrymal glands also may be enlarged.
2. INFLAMMATION OF UVEAL TRACTS.—Bilateral ; iridocyclitis, or choroido-retinitis or vitreous hæmorrhages. Sequelæ : posterior synechiæ, vitreous opacities.
3. NEURITIS.—Facial paralysis in 50 per cent ; unilateral or bilateral ; ascribed to parotitis. Recovery in few weeks.
4. ERYTHEMATA.—Occasionally on limbs.
5. PYREXIA.—Occasionally.

Pathology.—Tuberculosis.

Treatment.—Spontaneous recovery. Miliary tuberculosis recorded.

VI. MIKULICZ'S DISEASE.

Progressive chronic painless bilateral enlargement of lachrymal, parotid, and may be submaxillary glands. Cases classified as : (1) Mikulicz's disease. Idiopathic. Familial cases said to occur. (2) Mikulicz's syndrome. Associated with leukæmia, lymphosarcoma, syphilis, tuberculosis, and uveo-parotitis.

Pathology.—Small-celled infiltration or hyperplasia of lymphoid tissue.

Symptoms.—Slight in early stages ; dry eyes and mouth ; interference with vision. Swellings may become enormous.

Treatment.—Symptomatic.

CHAPTER LXXIX.

DISEASES OF THE PHARYNX.

I. ACUTE PHARYNGITIS.

Causes.—(1) Cold, especially after hot rooms ; (2) Constitutional conditions, e.g., gout, rheumatism, dyspepsia, also alcoholism. Occasionally : secondary syphilis ; trauma (in children). Is a cause of 'sore throat' : tonsils and soft palate often affected. Frequently part of a coryza.

Symptoms.—

LOCAL.—Tickling in throat and irritation causing cough ; pain on swallowing ; secretion early diminished, later much thick mucus. Neck muscles often stiff : occasionally palpable glands. Inflammation may extend to larynx (hoarseness) and Eustachian tube (deafness).

CONSTITUTIONAL.—Rarely severe. Slight fever and malaise.

PHARYNX.—Mucous membrane injected, swollen, and later covered with mucus.

Treatment.—Treatment as coryza often sufficient. Give aperient.

LOCAL.—Compress to neck, hot or cold. Inhalations (tinct. benzoin, co. $\frac{1}{2}$ j in pint of hot water) ; or spray with Dobell's solution. Paint pharynx with Mandl's paint, twice daily.

II. CHRONIC PHARYNGITIS.

Causes.—Numerous : (1) Tobacco or alcohol in excess. (2) Excessive use of voice, especially with faulty production or during acute pharyngitis ; very common in clergymen. (3) Repeated acute attacks. (4) Various constitutional conditions : gout, dyspepsia, anæmia, menopause.

Varieties.—Three groups :—

SIMPLE CATARRHAL PHARYNGITIS.—Congestion and mucus on pharynx, soft palate, and uvula.

GRANULAR HYPERTROPHIC PHARYNGITIS.—Small round swellings of lymphoid tissue around mucous follicles on posterior wall, especially laterally ; veins near distended ; mucus present : mainly in voice users.

ATROPHIC PHARYNGITIS or **PHARYNGITIS SICCA.**—Mucous membrane dry and glistening.

Symptoms.—(1) Discomfort in throat. (2) Impairment of voice. (3) Frequent irritable cough, throat sore. (4) Tenacious mucus in nasopharynx, much hawking ; may be blood-tinged.

Treatment.—

GENERAL.—The general health and cause of condition need treatment ; rest to voice ; abstention from alcohol, tobacco, and hot or spicy food ; regulate digestion and bowels ; change of air.

LOCAL.—Sprays, e.g., water with common salt ($\frac{1}{2}$ j in $\frac{3}{4}$ x), tinged with permanganate. Menthol pastilles.

GRANULAR PHARYNGITIS.—Touch nodules with galvano-cautery. Subsequently Mandl's paint, twice daily.

III. RETROPHARYNGEAL ABSCESS.

Suppuration in tissues between spine and posterior wall of pharynx.

Occurrence.—

1. **ACUTE.**—*Healthy children*, age 6 months to 2 or 4 years. Also not uncommon after measles and specific fevers.
2. **CHRONIC.**—Older children or adults : *caries of cervical vertebræ*.

Retropharyngeal Abscess, *continued*.

Symptoms.—(1) Malaise and pyrexia, altered voice, dyspnoea and dysphagia; (2) Head held back, chin forward, and mouth open; (3) Tumour in mid-line of pharynx, visible or easily palpable. Glands on one side of neck usually enlarged.

Prognosis.—Fatal not uncommonly: from oedema of larynx, suffocation by inspiration of pus, or cellulitis of neck.

Treatment.—Steam tent, or steam inhalations.

EVACUATE PUS.—Methods: (1) *Acute*: Through mouth with guarded bistoury. *Head must hang back* over table to prevent pus entering trachea. (2) *Chronic*: Laterally behind sternomastoid muscle.

IV. ACUTE SEPTIC PHARYNGITIS.

(*Ludwig's Angina. Cellulitis of Neck.*)

Severe infective inflammation of throat. Occurs in various degrees of severity, and inflammation spreads to varying extent. Has been described under many names. Severe forms rare, but serious.

Usually due to virulent streptococci.

Commonest in debilitated persons or alcoholics, but may attack those in good health.

Symptoms (severe case).—Onset often sudden with rigor and fever. Temperature variable, may be absent. Sudden pain in throat: swallowing impossible. Oedema of pharynx, bluish-red. Uvula greatly swollen.

May be confined to pharynx, or spread, reaching cervical cellular tissue (Ludwig's angina): may suppurate at any point.

Progress rapid; resolution often equally rapid.

Death may occur from asphyxia or pneumonia or, more commonly, toxæmia.

Treatment.—Hot fomentations. Incisions in neck: actual pus rare, but may discharge later if progress favourable. Oedema of larynx common. Treat toxæmia.

V. ULCERATION OF THE PHARYNX.

May be: (1) Follicular. (2) Specific fevers, diphtheria. (3) Epithelioma. (4) Tuberculosis. Rarely in severe pulmonary tuberculosis. Lupus: extends from nose: extensive destruction and deformity. (5) Syphilis (*see p. 231*).

VI. OEDEMA OF UVULA.

Usually from chronic interstitial nephritis; may be very great. Rarely in debility.

VII. DIVERTICULA.

See DIVERTICULA OF OESOPHAGUS, p. 405.

CHAPTER LXXX.

DISEASES OF THE TONSILS.

Classification.—(1) Acute tonsillitis. (2) Peritonsillar abscess (quinsy). (3) Chronic tonsillitis (chronic enlargement of tonsils). (4) Adenoids (enlargement of pharyngeal tonsil—included owing to close association).

I. ACUTE (FOLLICULAR) TONSILLITIS.

An acute bacterial infection of the faucial tonsils.

Etiology.—All ages; commonest in childhood; rare in infants.

Three groups of cases: (1) *Sporadic*. Often following cold or exposure, especially in ill-health or with chronic enlarged tonsils. (2) *Epidemic*. Not uncommon in schools, etc. Sporadic cases also are often infectious. (3) *Symptomatic*. Diphtheria, scarlet fever, measles, rheumatic fever and its allied conditions. Secondary syphilis closely similar. Diphtheria is only exceptionally follicular, and is dealt with separately.

Bacteriology.—*Streptococcus* is most common in severe types. Numerous organisms may occur.

Symptoms.—

LOCAL.—Sore throat; extreme dysphagia; pain often shoots to ears.

CONSTITUTIONAL.—Often severe; onset may precede sore throat. Shivering or rigor; pains in back and limbs; general malaise. Temperature 103° to 105° . Pulse rapid. Tongue furred, breath heavy. Constipation. Febrile urine.

ON EXAMINATION.—Tonsils swollen and red: white spots due to exudation in the crypts forming cheesy masses, confined to tonsils, and easily removed without a bleeding surface. Rarely a diffuse membrane.

Cervical glands often tender and palpable.

Duration.—Two to seven days.

Sequelæ and Fatalities.—Very rare in ordinary forms. May be otitis media. In epidemics, occasionally definite sequelæ, e.g., endocarditis, pneumonia, paralyses.

Diagnosis.—In *diphtheria*, membrane is continuous, not necessarily confined to tonsils, leaves bleeding surface on removal; temperature not so high; dysphagia and sore throat less marked. But may exactly imitate, or be imitated by, follicular tonsillitis. Culture to be taken, if any doubt.

From *scarlet fever*, measles, rheumatic fever, no diagnosis can be made by examination of fauces.

Acute (Follicular) Tonsillitis, *continued*.

Treatment.—Isolate patient.

GENERAL.—Saline aperients or mercury to obtain free motions.

LOCAL.—Hot fomentations to neck. Formamint lozenges to suck.

Wash mouth frequently; and gargle, if possible, with hydrogen peroxide (10 to 20 volumes), or spray with Dobell's solution.

Sodium salicylate (gr. x to xx, t.d.s.) often used.

ACUTE SEPTIC TONSILLITIS.

More severe grade of above. Virulent hæmolytic streptococci may be present. Constitutional symptoms severe. *On examination*: Extensive reddening of fauces and tonsils: exudation variable. May be very infectious. *Serious complications* may follow: quinsy, intratonsillar abscess, otitis media, suppuration of cervical glands; occasionally bronchopneumonia, or general septicæmia. *During convalescence*, often tachycardia.

II. PERITONSILLAR ABSCESS.

(Quinsy.)

Suppuration in peritonsillar tissues; may include parenchyma of tonsil. Acute and chronic tonsillitis are predisposing causes: also general ill-health and exposure.

Symptoms.—May commence as acute tonsillitis; symptoms abate, and then exacerbate. Malaise, fever, pain on one side of throat or neck radiating to ear. Salivation. Dysphagia. Tongue furred. Spasm of muscles causes stiffness of neck and prevents opening of mouth. Cervical glands enlarged and tender.

EXAMINATION.—Swelling to one side of soft palate: uvula displaced. Tonsil red, prominent, and œdematous: both may be affected. *Fluctuation* develops in 2 to 5 days: may rupture through soft palate and end attack, but opening may close and swelling recur.

Complications.—Uncommon. Œdema of larynx, suppuration of glands, septic complications: all rare.

Treatment.—Hot fomentations to neck. Mouth-washes of hot water, or hydrogen peroxide (10 to 20 volumes).

WHEN FLUCTUATING.—Incise through mouth with guarded curved bistoury. Incisions in *soft palate* from above down and inwards towards uvula, to avoid vessels near tonsils. Subsequently, frequent mouth-washes.

Convalescence.—Not to be hurried. Tonics. Tonsillectomy for recurrent quinsy, but not in acute stages. Heart to be watched.

III. CHRONIC TONSILLITIS.

Two types may be distinguished:—

Chronic Parenchymatous Tonsillitis ('Enlarged Tonsils').—

In children: adenoids are usually present. For symptoms, *see* ADENOIDS, p. 399.

TREATMENT.—Tonsillectomy.

Chronic Follicular Tonsillitis.—In older subjects. Fibrosis and atrophy following hypertrophy. Crypts contain caseous matter. Tonsils often small.

SYMPTOMS.—Foul taste and breath, recurrent sore throats, dyspepsia, fibrositis, and rheumatism.

TREATMENT.—Tonsillectomy. In mild cases, cautery or Mandl's paint.

IV. ADENOIDS.

(*Hypertrophy of Pharyngeal Tonsil.*)

Hypertrophy of the glandular lymphoid tissue normally present in the nasopharynx, sometimes called the 'pharyngeal tonsil'.

The presence of adenoids is a heavy handicap to the physical and mental development of a child, and careful and complete removal is essential.

Etiology.—Age, 5 to 10 years, persisting through puberty. Possibly more frequent in damp climates. Hereditary or familial factor common. Extremely frequent, and present in a high percentage of school children.

Morbid Anatomy.—Red vascular irregular masses in the vault of the pharynx, formed of hypertrophied lymphoid glandular tissue, covered with epithelium. In older patients, after recurrent inflammation, fibrous tissue increased, growths firmer and bleed less readily. Size, a pea to a considerable mass.

Tonsils usually but not invariably enlarged. Chronic nasal catarrh usual.

Symptoms.—Result directly and indirectly from nasal obstruction and mouth-breathing.

MOUTH-BREATHING.—Often first symptom noticed by parents. Worse at night; snoring; noisy irregular respiration; disturbed sleep and nightmares. May be definite dyspnoea. Cough, dry and nocturnal, common without bronchitis. 'Snuffling' common from nasal catarrh.

FACIAL APPEARANCE.—Characteristic '*adenoid facies*': Face lengthens, appearance expressionless. Nose pinched, alæ nasi fall in. Mouth open. Upper lip often retracted; hanging lower jaw. Roof of mouth raised and superior dental arch narrowed. Teeth irregular and often carious. Pallor common. Frequently deficient general growth.

HEARING.—Deficient. Very important. Due to: (1) Extension of inflammation. (2) Obstruction of orifices by adenoids, and (3) Absorption of air in Eustachian tubes; also (4) Otitis media common.

VOICE.—Loses resonance; tone nasal. Substitution of letters *B* and *D* for *M* and *N*.

MENTAL CONDITION.—General dullness and inability to fix attention ('aproxia'), resulting from above factors, e.g., deficient hearing, bad sleep.

Adenoids—Symptoms, *continued*.

RESPIRATORY TROUBLES.—Common: *bronchitis*, *coryza*, *tracheitis*, *laryngitis*. (Air inspired not warmed and moistened by nasal mucous membrane.)

SHAPE OF THORAX.—‘*Pigeon breast*’ common type; sternum prominent; Harrison’s sulcus at attachment of diaphragm; section through thorax becomes triangular; costochondral junctions often depressed; occasionally lower end of sternum deeply depressed (funnel breast). Changes result from obstruction to inspiration and falling-in of yet unhardened structures.

CERVICAL LYMPHATIC GLANDS.—Often palpable: from recurrent inflammation.

GASTRO-INTESTINAL DISTURBANCES and intestinal parasites are common. Probably associated with general overgrowth of lymphoid tissues.

VARIOUS SYMPTOMS.—Headache, foetor of breath. Nocturnal enuresis, asthma, habit-spasms are often ascribed to adenoids.

Note.—A child properly taught to breathe through the nose may continue to do so after development of adenoids. Symptoms due to mouth-breathing are absent, and principal results are lethargy, recurrent coryza, and ear troubles.

Diagnosis.—By ‘adenoid facies’ and above symptoms. Adenoids not visible from mouth, but palpable on digital examination. Tonsils usually enlarged.

Prognosis.—Good with efficient and early treatment. Atrophy usually occurs at puberty.

Treatment.—Operation.

General health, if deficient, should be improved *before* operation.

After operation, tonics and attention to general health important.

Chin-strap at night, if mouth-breathing persists. Systematic breathing exercises of great value.

CHAPTER LXXXI.

DISEASES OF THE ŒSOPHAGUS.

I. ŒSOPHAGITIS.

Acute Œsophagitis.—Except when origin is traumatic, is rarely of clinical importance.

ETIOLOGY.—

1. Acute catarrhal Œsophagitis: (a) Extension from acute pharyngitis; (b) In specific fevers, may extend from pharynx; (c) Idiopathic.

2. Traumatic: boiling water, foreign bodies, corrosives, etc.

MORBID ANATOMY.—In catarrhal form, mucosa swollen, covered with mucus. Phlegmonous inflammation may follow foreign bodies or phlegmonous gastritis: gangrene may result.

SYMPTOMS.—Pain on swallowing ; pain under sternum ; severity varies.

TREATMENT.—Ice by mouth ; morphia. Olive oil.

Chronic Œsophagitis.—From causes of chronic pharyngitis, alcohol, etc. Dysphagia and symptoms of causal condition.

Œsophageal Varices.—Occur in chronic heart disease and cirrhotic liver. Rupture of vein causes hæmatemesis, or rarely melæna only : frequent in cirrhotic liver.

Rupture of Œsophagus.—Very rare. Usually from severe vomiting : may be previous trauma or ulceration. Ruptures transversely at lower end, often into left pleural cavity. Great pain and distress. Always fatal.

Ulceration.—Occurs as peptic ulcer, very rarely (*see below*) ; also from trauma, cancer, aneurysm, syphilis, tuberculosis, rarely in diphtheria and debility. Dysphagia. Diagnosis by œsophagoscopy.

II. PEPTIC ULCERATION OF THE ŒSOPHAGUS.

Acute Ulceration.—From repeated vomiting in debilitated subjects : acid juice acts on lower end of œsophagus. Commonly post-operative ; rarely pyloric obstruction and other causes.

SYMPTOMS.—Pain behind sternum. Hæmatemesis occasionally. Rarely, perforation into pleural cavity.

Chronic Ulceration.—May arise from secretion of HCl and juice from ectopic gastric mucous membrane in pharynx or œsophagus (cf. Meckel's diverticulum) : ulcer forms above cardia. Diaphragmatic hernia often associated (Hurst).

SYMPTOMS.—Heartburn ; pain on feeding may spread to left shoulder ; food may 'stick' behind sternum.

COMPLICATIONS.—*Hæmatemesis* ; perforation. Obstruction may develop later. Gastric and duodenal ulcer and hyperchlorhydria may coexist.

RADIOGRAPHS.—Normal, or evidence of spasm or irregularity above cardia.

TREATMENT.—As in peptic ulcer, but meals taken sitting erect in bed. Bougies if obstruction.

III. SPASM OF THE ŒSOPHAGUS.

(*Œsophagismus. Spasmodic Stricture.*)

Spasm of œsophagus may occur as : (1) Neurosis—'spasmodic stricture' ; (2) Local reflex in organic diseases—e.g., in neoplasm or acute œsophagitis. Also in rabies and pseudo-rabies.

Spasmodic Stricture.—Not common, but diagnosis important. In neurotic persons, hypochondriacs. All ages, and both sexes. Onset often attributed to mythical swallowing of foreign body, which has 'stuck', maybe years previously. Attacks often transient, especially at first.

Spasm of the Œsophagus, *continued*.

SYMPTOMS.—Complaint of : (1) Inability to swallow, maybe even liquid ; (2) Substernal pain. Food may be regurgitated. Globus hystericus and emotional disturbances common. Not emaciation, but may be loss of weight. No symptoms, and œsophagus normal in intervals between attacks.

Bougie passes (a) without arrest, or (b) with temporary arrest.

RADIOGRAPH WITH BARIUM MEAL.—(1) Arrest of barium is complete temporarily ; (2) Outline of œsophagus is regular and symmetrical, with conical end ; (3) No dilatation. Thus differs from neoplasm, in which outline is irregular and some barium trickles through ; and from achalasia of cardia, in which œsophagus is dilated.

TREATMENT.—Passage of bougies. General.

PROGNOSIS.—Good, but relapse frequent.

Cardiospasm.—This term is unfortunately applied to two different conditions : (1) Spasmodic stricture (as described above) ; (2) Idiopathic dilatation of the œsophagus (*see below*).

IV. IDIOPATHIC DILATATION OF THE ŒSOPHAGUS.

(*Achalasia of the Cardia. Cardiospasm.*)

Morbid Anatomy.—Generally affects lower two-thirds of œsophagus : spindle-shaped, narrowing to normal at diaphragm. Two important phenomena : (1) Muscular wall of œsophagus always hypertrophied and dilatation present ; (2) Cardiac sphincter not hypertrophied, with rare exceptions. Auerbach's plexus in cardiac sphincter may be degenerated.

Mode of Origin.—Muscular hypertrophy proves presence of obstruction : negatives Mackenzie's theory of atony of the wall. Principal theories are :—

1. Failure of the co-ordinating mechanism which produces relaxation of the cardiac sphincter during swallowing (Hurst, "Achalasia of the Cardia"). *Physiology* : As each peristaltic wave passes down the œsophagus in the act of swallowing, a stimulus normally passes through a reflex arc to the longitudinal muscular fibres of the œsophagus, which then contract and open the cardiac sphincter, thus allowing the ingesta to enter the stomach. *Experimental production* : The longitudinal fibres are supplied by the vagus, and are paralysed by its division (Langley, in cats) ; with subsequent feeding, if vagus be divided below the recurrent laryngeal nerve, Cannon has produced dilatation of œsophagus with muscular hypertrophy, viz., a condition similar to that occurring in man. *Conclusion* : Inco-ordination between the passage of a peristaltic wave and the contraction of the longitudinal muscular fibres which open the cardiac sphincter will

explain nearly all instances of idiopathic dilatation. *Mode of action*: Food collects, whence: (a) œsophagus dilates, (b) stimulus of food causes strong contraction and thus hypertrophy.

2. Cardiospasm, viz., spasm of the sphincter fibres at lower end of circular coat of œsophagus. In this event, hypertrophy of sphincter would be expected: certainly usually absent, but presence is recorded in a few instances.
3. Kinks of lower end of œsophagus. Presence in certain cases shown by œsophagoscopy and opaque meals. Probably secondary.

Œsophagitis above cardia may be exciting factor.

Symptoms.—Usually no cause of origin found. Attacks at first transient, with long intervals. In course of months or years, condition becomes permanent. Patient complains of food 'sticking' behind sternum: may be pain. Often regurgitates to obtain relief. *Occult blood never present*. At onset, loses weight rapidly: subsequently stationary for years.

RADIOGRAPHS WITH BARIUM.—Note: (1) Œsophagus greatly dilated; (2) Outline regular; (3) Obstruction localized to sphincter, but may be irregularity at cardia.

Diagnosis.—From cancer, by: (1) Long duration; (2) Early attacks intermittent; (3) Radiographs—regular outline; (4) Œsophagoscopy.

Treatment.—Passage of bougies: Hurst's mercury tube best.

Paralysis of the Œsophagus.—Occurs in certain central nervous diseases—e.g., bulbar paralysis—in hysteria, and in diphtheria. Very rare. Dysphagia without regurgitation.

TREATMENT.—Stomach tube, and treat cause.

V. ŒSOPHAGEAL OBSTRUCTION.

Causes.—

1. CONGENITAL ATRESIA.—(i) Œsophagus ends at bifurcation of trachea: lower segment arises from trachea or bronchus and opens into stomach. No case has survived. (ii) True stenosis: very rare.
2. CICATRICIAL STRICTURE.—(i) Corrosives: site either high near pharynx, when food immediately regurgitated and no dilatation occurs, or low near diaphragm, when dilatation and hypertrophy of œsophagus may follow. (ii) Syphilis: very rare: diagnosis usually doubtful.
3. TUMOURS IN WALL.
4. EXTRINSIC TUMOURS.—Aneurysm; enlarged thyroid; lymphatic glands; neoplasms, etc.
5. IDIOPATHIC DILATATION OF ŒSOPHAGUS.
6. SPASMODIC STRICTURE.
7. DIVERTICULA.
8. FOREIGN BODIES.
9. PLUMMER-VINSON SYNDROME.

Most frequent causes are: (1) Neoplasm; (2) Aneurysm.

Œsophageal Obstruction, continued.

Diagnosis.—(1) *Clinical*: (a) Regurgitation of unaltered food; (b) Dysphagia; (c) Various signs and symptoms. (2) *Radiography*. (3) *Œsophagoscopy*. Auscultation of deglutition unreliable. Bougies dangerous.

Treatment.—Varies with cause. Following corrosives: slow dilatation with bougies, at first twice weekly, later once a month.

VI. CANCER OF THE ŒSOPHAGUS.

Occurrence.—(1) Males 80 per cent, 50 to 55 years. (2) Growth primary. (3) Epithelioma; early ulceration.

Lumen is obstructed, and dilatation and hypertrophy may occur above, but degree is rarely great.

Sites.—(1) Retro-cricoid; (2) Bifurcation of trachea; (3) Lower third. Males: mainly lower third. Females: usually retro-cricoid.

Symptoms.—

1. **DYSPHAGIA.**—Invariably initial complaint. Progressive without appreciable intermissions. In 1 to 4 months unable to swallow solids.
2. **EMACIATION.**—Rapid. On inquiry, loss of weight and ill health have often preceded dysphagia. Anæmia rapid.
3. **REGURGITATION.**—Appears as condition advances. Often foul. Gives relief. In retro-cricoid growths, occurs immediately after food with coughing.
4. **PAIN.**—Variable: (i) *Discomfort*. Early: often referred to pharynx from reflex spasm: with retro-cricoid growths referred to ear. (ii) *Actual pain*. Later: referred to site: often in back. Subsequently from various extensions of growth.

Cervical glands may be enlarged, frequently not. Growth never extends down to stomach and is not palpable (but cardiac neoplasm may extend up).

Extension of Growth.—(1) Into lungs and bronchi, etc. Spasmodic cough. Physical signs of any type posteriorly at base. (2) Pressure on recurrent laryngeal (hoarseness). (3) Hæmatemesis. (4) Perforation. (5) Pressure on cervical sympathetic (Horner's syndrome).

Diagnosis.—Usually easy. Principally from aneurysm and forms of 'cardiospasm'. *Radiography*: Irregular obstruction; barium trickles through. *Œsophagoscopy*.

Treatment.—

INTUBATION.—Souttar's tube: good temporary results.

GASTROSTOMY.

RADIUM.—Implantation of radon seeds or deep X-ray therapy: results bad at present. Excision has been accomplished in a few cases.

VII. DIVERTICULA AND DILATATIONS.

Diverticula or Œsophageal Pouches are protrusions of part of wall of Œsophagus (or pharynx). Two types :—

1. **PRESSURE OR PULSION DIVERTICULA.**—These are entirely pharyngeal and *not* Œsophageal. They develop on posterior wall between upper and lower divisions of inferior constrictor of pharynx: here lumen is narrow, with cricoid cartilage in front. Lower division closes lower end of Œsophagus at rest but should relax during deglutition. Pouch formed is enlarged by food, becomes most direct continuation of pharynx and pushes into neck, usually on left from position of Œsophagus: wall is thick, diameter of pouch several inches. Usually in old age. Probably acquired and not congenital.

Symptoms: Progressive difficulty in swallowing. Loud gurglings. Pouch can be emptied by pressure. *Treatment:* Operation—results good: otherwise may be finally death from wasting.

2. **TRACTION DIVERTICULA.**—On anterior wall, at bifurcation of trachea: from cicatrization and contraction of adherent lymphatic glands. Rarely exceed one inch. No symptoms unless perforated by foreign body from food: occasionally enlarged by pressure of food.

Diagnosis.—Opaque meal and radiography.

Dilatation of Œsophagus.—

1. **PRIMARY IDIOPATHIC DILATATION.**—See p. 402.
2. **SECONDARY TO OBSTRUCTION.**

VIII. DYSPHAGIA ASSOCIATED WITH ANÆMIA.

(*Plummer-Vinson Syndrome.*)

Priority of description belongs to Brown Kelly (1919) and Paterson (1919). Essential symptoms are dysphagia, microcytic anæmia, and atrophy of mucous membrane of mouth. Pathogenesis in dispute.

Characteristics.—

1. Practically confined to women. Age 35 to 60 years. Usually edentulous and debilitated.
 2. Difficulty in swallowing: at level of pharynx. Insidious or sudden. Progressive.
 3. Microcytic anæmia. Ordinary symptoms of this condition present. Rarely with megalocytosis.
 4. Atrophy of mucous membrane of tongue. Lips often affected.
 5. Achlorhydria usual: not invariable. Spleen occasionally palpable.
 6. Œsophagoscopy: difficulty owing to narrow opening. Often normal, but may be bands of tissue.
 7. Radiographs: usually normal.
 8. Treatment: bougies. Treat anæmia.
- Anæmia precedes dysphagia: latter appears to be additional feature complicating anæmia.

Dysphagia Associated with Anæmia, *continued*.

Theories.—

1. Feeble reflex stimulus due to atrophic mucous membrane of mouth results in incomplete opening of pharyngo-œsophageal junction. Swallowing also impeded by muscular weakness. (W. Hill.) Reasonable theory. *Note*: Lower division of inferior constrictor of pharynx closes junction at rest but should relax during deglutition.
2. Atrophy of mucous membrane of mouth extends back to pharynx and involves Auerbach's plexus, thus producing 'achalasia' as in cardiospasm (Hurst). *Note*: Auerbach's plexus is stated not to exist at this site.
3. Spasm of muscles at pharyngo-œsophageal junction (Brown-Kelly). *Note*: Some authorities deny evidence of spasm.

CHAPTER LXXXII.

DISEASES OF THE STOMACH AND DUODENUM.

I. ACUTE GASTRITIS.

(*Acute Gastric Catarrh*.)

Acute inflammation of the mucous membrane of the stomach, resulting in gastric symptoms and varying constitutional disturbances. Often associated with entero-colitis.

Etiology.—Occurs at all ages, but origin varies. Common causes:—

1. **FOOD** (Irritant Gastritis).—'Errors of diet': (a) Quantity excessive; (b) Quality coarse or rich. Alcohol. Food-poisoning.
2. **TOXIC**.—Irritant and corrosive poisons, viz., strong acids and alkalis, arsenic, phosphorus, etc.
3. **SYMPTOMATIC**.—Onset of acute infectious disease. Uræmia.
4. **SPECIAL TYPES**.—Phlegmonous and diphtheritic gastritis.

Predisposing causes include:—

IDIOSYNCRASY.—Common with individuals and families, either general or due to special articles of diet.

CHILDHOOD AND INFANCY.—Especially from food, unripe fruit, and infectious disease.

Anæmia. Exposure to cold and wet, and extremes of temperature. Gout, chronic nephritis, diabetes, etc.

Morbid Anatomy.—

MACROSCOPIC.—Mucous membrane swollen and hyperæmic, with covering of mucus: may be hæmorrhages.

HISTOLOGY.—Swelling of mucous cells. Leucocytic infiltration.

GASTRIC JUICE.—Scanty. Increase of mucus. Usually diminution or absence of HCl: not increased.

Symptoms.—Vary greatly with cause and severity.

MILD TYPE.—Abdominal discomfort; anorexia; furred tongue; nausea; vomiting, giving relief. Headache common. Apyrexia, or rise slight. Duration, 24 to 48 hours.

SEVERE TYPE.—Onset sudden: may be slight rigor. Fever, 102° to 103°. 'Nasty taste in mouth', conjunctivæ dull, tongue furred, breath heavy, anorexia, thirst. Headache, giddiness, and mental inertia. Extremities cold. *Vomiting* of food, then bile. Acid *eructations*; may cause 'heartburn' or set teeth on edge. Epigastric tenderness, distension of stomach by gas. Constipation, or not uncommonly diarrhoea. Urine of febrile type. Duration 1 to 3 days. Depression for several days.

Diagnosis.—Differential diagnosis of simple from symptomatic forms often impossible.

ACUTE INFECTIOUS DISEASES.—Suggested by pyrexia and *absence of dietetic error*: specially in children.

INTRACRANIAL DISEASE.

PERITONITIS, INTESTINAL OBSTRUCTION, APPENDICITIS.—Abdominal physical signs. Vomiting usually more marked.

TABETIC CRISES.—Test for evidence of syphilis.

GALL-STONE COLIC.—Distribution and character of pain.

TOXIC CAUSES, e.g., arsenic.—Special tests of gastric contents, etc., when poisoning suspected.

Numerous causes of gastric disturbances: catarrhal jaundice, migraine, vomiting of pregnancy.

Treatment.—

MILD FORM.—Low diet. Castor oil or calomel.

SEVERE FORM.—*Indications*: (1) Remove irritant from stomach; (2) Rest for stomach.

GENERAL.—Warmth, especially to extremities. Mustard leaf or poultice to epigastrium, if tender. Hot water freely.

DRUGS.—Calomel, gr. ij to iij (adult), followed by saline purge. If diarrhoea, castor oil (℥ss) with tinct. opii ℥ x.

VOMITING.—Aid by warm water, several tumblers: tickle fauces if necessary: repeat: eases acid eructations, nausea, and vomiting. Stomach wash if severe, and acid. hydrocyanic. dil. ℥iij to v, with bismuth.

DIET.—Soda-water, as desired, or lime-water. Later, diluted milk.

PERSISTENT DIARRHOEA.—Mist. cretæ (B.P. 1914), adding tinct. opii ℥v to x if necessary, or pulvis cretæ aromaticus c. opio gr. xx to xxx, t.d.s.

WITH IMPROVEMENT.—*Diet*: Farinaceous foods, tea, boiled fish. Avoid fats. *Drugs*: As gastric sedative:—

R	Bismuth. Carb.	gr. xx	{	Mucil. Trag.	q.s.
	Sodii Bicarb.	gr. xx		Aq. Menth. Pip.	℥j
		t.d.s.,		p.c.	

TOXIC CASES.—Special treatment, depending on cause.

Prognosis.—Chronic or subacute gastritis may follow repeated attacks. Immediate recovery usually complete.

Acute Gastritis, *continued*.**MEMBRANOUS OR DIPHThERITIC GASTRITIS.**

Very rare. Usually in children. No primary form. Secondary process, rarely in diphtheria, more often in small-pox and other fatal debilitating conditions. No special symptoms.

PHLEGMONOUS GASTRITIS.

Diffuse Phlegmonous Gastritis.—Rare. Widespread infection of *submucosa*, usually by streptococci, i.e., cellulitis of stomach. Infection may be through ulcer, neoplasm, operation wound; occasionally puerperal fever; may be no obvious cause. More common in males.

MORBID ANATOMY.—Walls thickened, homogeneous red jelly appearance, very friable. Peritoneal adhesions and inflammation present. *Histology*: Œdema and marked cellular infiltrations, especially near pylorus; mucous membrane but slightly affected. No collections of pus.

SYMPTOMS.—*Severe sepsis with abdominal symptoms*. Onset sudden; often rigor. Pain in upper abdomen, rigidity and tenderness. *Vomiting* early. High temperature, rapid pulse, and marked constitutional disturbance. Tender *tumour* may be palpable. *Acute peritonitis* if life sufficiently prolonged. Stomach may rupture.

PROGRESS AND PROGNOSIS.—Collapse increases. Condition as in acute septicæmia. Fatal in few days.

Circumscribed Type.—*Localized abscess* of stomach wall. Very rare. Usually cancer present. Has been successfully evacuated.

II. CHRONIC GASTRITIS.

Chronic inflammation of the gastric mucous membrane. The study and knowledge of chronic gastritis has increased rapidly in recent years, but the correlation of the various types with clinical and chemical features is uncertain, and relationship to neoplasms and ulcer is in dispute. Advances are especially due to: (1) Faber—rapid fixation of stomach with formalin immediately after death; (2) Schindler—development of gastroscopy; (3) Konjetzny—histological studies (material obtained from surgical resections of stomach and pylorus for severe lesions, and conclusions as to gastritis must be received with caution).

Etiology.—Persistent and recurrent causes of acute gastritis. Constitutional factors probably important. Various factors—e.g., chronic sepsis, congestion from circulatory congestion. Little understood.

Types.—Three types may be recognized: (1) Chronic atrophic gastritis; (2) Chronic hypertrophic gastritis; (3) Chronic superficial (or catarrhal) gastritis. All forms may be present in the same stomach at different sites.

1. CHRONIC ATROPHIC GASTRITIS.—

MORBID ANATOMY.—Mucous membrane thin, smooth, and pale; generalized, but advanced in fundus and cardia. Mucus increased.

Histology.—General atrophy and fibrosis.

GASTRIC SECRETION.—HCl diminished or absent.

SEQUELÆ.—May be cancer. Also megalocytic anæmia.

TREATMENT.—*Acids*: may relieve. *Alkalis*: benefit slight.

Diet: light; not milk.

2. CHRONIC HYPERTROPHIC GASTRITIS.—

MORBID ANATOMY.—Nodular areas in which mucous membrane velvety and swollen: commoner towards pylorus; may be erosions and some hæmorrhages. Mucus scanty.

Histology.—Proliferation of glandular elements; swelling of lymph-follicles; infiltration of interstitial tissue with round cells and eosinophils; some fibrosis in deeper layers.

GASTRIC SECRETION.—HCl normal or increased.

COURSE AND SEQUELÆ.—Never heals; remains permanently.

Erosions may form: heal in one to two weeks. *Hæmorrhages may be severe and recurrent*. Never perforates. Never progresses to atrophic gastritis or cancer. No relation to gastric ulcer (Schindler; other authorities have assumed that it is precursor of peptic ulcer; at present unsettled). Polyposis may develop, very rare.

TREATMENT.—Alkalis relieve. Treat as for chronic gastric ulcer.

3. CHRONIC SUPERFICIAL GASTRITIS.—

MORBID ANATOMY.—Ordinary changes of chronic inflammation of mucous membrane. Mucus covering and between folds.

GASTRIC SECRETION.—Diminished, may be temporary.

COURSE.—May heal or may progress to atrophic but never to hypertrophic gastritis.

TREATMENT.—Rest. Lavage.

NOTE.—*Porges' Theory*: Gastritis localized to pyloric end (an 'irritant' gastritis) stimulates acid cells at cardiac end, producing hyperchlorhydria and peptic acid. Generalized gastritis (hæmatogenous or toxic) affects entire gastric mucosa and produces achlorhydria. Based on (possible) theory that pyloric cells secrete: (1) stimulant to acid cells of cardia; (2) alkaline juice; (3) hæmopoietin.

Symptoms.—No characteristic features. Often latent, especially hypertrophic form. Symptoms include:—

APPETITE.—Poor. May be normal.

EPIGASTRIC DISCOMFORT.—Onset variable: in atrophic form shortly after food; in hypertrophic form after interval.

Heartburn, flatulence, nausea may be present. Tongue often clean. No definite physical signs. May be ill-defined tenderness.

Radiography.—No assistance as to mucous membrane. Motility may be normal, or rapid emptying or combined with periods of inertia.

Diseases of the Stomach and Duodenum, *continued*.

III. DYSPEPSIA.

Consciousness of or discomforts due to the activities of the stomach. Physiological appetite forms an exception. Normally there is ~~in~~ consciousness of the presence or absence of food in the stomach, except a physiological degree of appetite and a feeling of pleasant repletion.

Dyspepsia is not a morbid entity, but a group of symptoms due to various physiological or pathological activities of the stomach. This section gives descriptions of the various symptoms and types.

Classification.—Three groups of conditions may be separated:—

I. ORGANIC DYSPEPSIA.—Pathological changes recognizable in tissues of the walls: Carcinoma, gastric ulcer, duodenal ulcer, chronic gastritis, dilatation of the stomach.

II. FUNCTIONAL DYSPEPSIA.—No obvious pathological changes. Attributed to disorders of the functions:—

1. DISORDERS OF THE MOTOR FUNCTIONS.—(a) Hypermotility, or hypertony; (b) Atony or hypotony.

2. DISORDERS OF THE SECRETORY FUNCTIONS.—(a) Hyperchlorhydria and hypersecretion; (b) Hypochlorhydria and hyposecretion.

3. DISORDERS OF THE SENSORY FUNCTIONS.

III. NERVOUS DYSPEPSIA.—*Neuroses of the stomach*.

NOTES.—

Group I.—See under separate headings. Not further considered in this section except generally in etiology.

Group II.—The term 'functional' as used here denotes disturbances of functions, many of which are recognizable by ordinary methods of gastric examination.

Group III.—'Nervous' corresponds to the sense in which 'functional' is often used, though loosely, in ordinary medical parlance.

These groups are largely arbitrary and not sharply divided. 'Dyspepsia', therefore, includes numerous cases classifiable either as chronic gastritis or functional forms on the one hand, or as functional forms or neuroses on the other hand. Temporary attacks of dyspepsia similarly merge into certain forms of 'acute gastritis', viz., from errors of diet, but 'dyspepsia' is never applied to severer forms, e.g., toxic poisoning.

Anæmia and Gastric Defects.—Association is discussed under ANÆMIA.

GENERAL ETIOLOGY.

Causes are: (1) Physical habits; (2) Dietetic; (3) Local disease of stomach and other organs; (4) Constitutional diseases; (5) Neuroses.

Physical Habits of Life.—(1) *Imperfect mastication*. Especially deficient and carious teeth. Hurried meals. (2) *Irregular meal times*. (3) *Deficient exercise*. Work immediately after meals (physical or mental). Over-exertion. (4) *Constipation*. (5) *Bad cooking*. Dirty cooking utensils.

Dietetic.—(*Mainly excesses.*) (1) *Alcohol.* Spirits. Light wines, owing to acidity. New beer: fermentation incomplete and continues in stomach. Spirits act specially on liver; wines and beer mainly on stomach. (2) *Tea*, overdrawn. Tannin, hardens meat fibre. Appetite, physiologically correct, dictates tea for farinaceous and not for meat meals. (3) Excessive fluid during meal: (a) Dilutes gastric juice; (b) Softens food with water instead of saliva and ferments; and aids insufficient mastication. (4) Excess of solids. (5) Fats in excess: possibly, as no digestion of fat occurs in stomach. When splitting of neutral fat occurs in stomach by action of bacteria, resulting butyric acid irritates. Free butyric acid is present in rancid butter. (6) Heavy pastry, hot bread, pies. Common in America. (7) Sugar in excess. Causes over-secretion of mucus. (8) *Tobacco in excess*: especially on empty stomach. (9) Deficient fluid. *Various other articles*: Fruit, over-ripe or unripe. High meat. Chewing tobacco (excessive salivation). Vinegar in excess. Power of digestion varies greatly in different individuals. *Idiosyncrasies* to various articles are very common and often hereditary.

Local Disease.—

STOMACH.—Cancer; ulcer; dilatation; visceroptosis; gastritis.

OTHER ORGANS.—(1) *Liver: cirrhosis* impedes gastric circulation. (2) Chronic heart disease: through portal circulation; also 'epigastric angina'. (3) Gall-bladder. (4) Appendicitis (see p. 469). Occasionally: colitis, movable kidney.

Constitutional Diseases.—

PHTHISIS.

NEPHRITIS, GOUT, ANÆMIA, and all debilitating diseases.

Neuroses.—See NERVOUS DYSPEPSIA, p. 415.

Common Causes without Grave Illness.—(1) Deficient teeth;

(2) Alcohol; (3) Tobacco; (4) Anæmia; (5) *Early phthisis*.

GENERAL SYMPTOMS.

Often chronic, but intermissions and variations in intensity occur.

Summary of Symptoms.—

1. Epigastric discomfort. Varies from oppression to acute pain.
2. Flatulence. Also acid eructations, water-brash.
3. Nausea and vomiting. Latter rarely prominent.
4. Alteration of appetite. Usually diminished.

Other Symptoms.—Sallow complexion: conjunctivæ muddy. Tongue furred. Bad taste in mouth. *Teeth* carious or deficient. Constipation. Occasionally diarrhœa. Cough: usually from pharyngeal mucus. Temperature normal. Pulse often slow: may be palpitation. Giddiness. Often mental depression and inertia, irritability, frontal headache, cold extremities.

1. Epigastric Discomfort.—Varies in degree. May be due to:—

1. Gastric distension: from atony or air-swallowing, or both: sense of fullness and oppression. Tenderness slight.

Dyspepsia—General Symptoms, *continued*.

2. Regurgitation into œsophagus: 'heartburn'; may be localized precordial or sternal pain or in pharynx.
3. Organic disease, e.g., ulcer: true pain; tenderness either deep and local at site of lesion, or of superficial muscles from reflex.
4. Distension of pelvic colon.

HEARTBURN (OR CARDIALGIA).—Due to regurgitation of acids, organic or hydrochloric, into œsophagus: may follow a bland fluid, e.g., tea, from increasing distension of stomach and relaxation of cardia. Eased by fluids, whence swallowing of saliva. Contractions of the œsophagus may be a factor of the pain. May be felt at upper end of œsophagus or in pharynx from reflex spasm.

2. Flatulence.—Gastric flatulence occurs in:—

1. **FLATULENT DYSPEPSIA.**—(1) Usually in middle age, with deficient teeth and hypochlorhydria; (2) May be a prominent symptom in hyperchlorhydria; (3) Less constant in dilatation of stomach.

2. **CARDIAC PAIN, ANGINA, GALL-STONE COLIC.**—Origin doubtful: air probably swallowed during pain. Cessation of pain often associated with copious eructation. In diaphragmatic hernia: often intense.

3. **AIR SWALLOWING (ærophagy).**—In any condition of epigastric discomfort. Also as pure neurosis (eructatio nervosa).

SYMPTOMS.—Fullness and discomfort in epigastrium. Palpitation, cardiac discomfort, dyspnoea from pressure on diaphragm.

ORIGIN OF GAS IN STOMACH.—*Note:* In mild dyspepsia, nearly always due to swallowed air.

SWALLOWED AIR.—(1) With food: considerable with deficient mastication. More with fluids than solids. (2) With saliva: amount considerable, hence flatulence in pharyngeal irritation. (3) Air-swallowing. Occurs with: (a) gastric disturbances—e.g., hypo- or hyperchlorhydria, gastritis, dilatation; (b) pain near diaphragm; (c) neurosis; (d) combination of neurosis and gastric disturbance (common).

BACTERIAL FERMENTATION.—In hypochlorhydria; mainly from cellulose, as in cabbages. Only occurs with dilatation and delay; otherwise stay of food in stomach is insufficient for much gas formation. In pyloric neoplasm may be very foul.

DEFICIENT ABSORPTION.—Little known. Possibly in atrophic gastritis.

From action of HCl on ingested carbonates. Possibly also from regurgitation of alkaline pancreatic juice.

Nature of Gases.—Atmospheric gases; may also be CO₂. With fermentation, CH₄. Rarely H₂S. Occasionally inflammable.

AIR SWALLOWING.—Habit often acquired unconsciously by subjects with no neurotic factor. Epigastric distension or discomfort of any origin—e.g., slight dyspepsia or distended splenic flexure—may produce sensation that eructation will cause relief.

Attempts to eructate in such circumstances result in swallowing air. After repetition, stomach is sufficiently distended for eructation of the swallowed air to occur, with apparent relief for a moment. Discomfort returns and cycle is repeated. Enormous flatulence thus simulated. By simple explanation to subject and restraining all attempt at eructation, flatulence of great severity and long duration is often aborted in a few days. Air may be *swallowed* in gulps, or *sucked in* by respiratory movements with closed glottis.

DIAGNOSIS.—From distended stomach, distended splenic flexure.

Also rarely from spasm of diaphragm (as in pseudo-cyesis).

TREATMENT.—Causal condition and aerophagy. Hot water. Peppermint, oil of cinnamon on lump of sugar.

ERUCTIONS.—Relieve gastric, but not intestinal flatulence.

ACID ERUCTIONS.—May be: (1) Organic acids in hypochlorhydria and flatulent dyspepsia; (2) Hyperchlorhydria.

WATER-BRASH.—The irritation of acid eruptions and heart-burn may cause excessive secretion of saliva, which fills the mouth as clear fluid, slightly alkaline to litmus. Amount may be very large: possibly accumulates at lower end of oesophagus owing to spasm of cardiac sphincter.

PYROSIS.—Properly a strongly acid fluid brought up to mouth from stomach; much rarer. Amount small.

INTESTINAL FLATULENCE.—Mainly from fermentation, e.g., in carbohydrate dyspepsia. Often with gastric flatulence.

3. Vomiting.—See also p. 421.

FREQUENCY.—Varies, but rarely a prominent symptom in non-organic dyspepsia. Results from: (1) Condition of stomach contents; (2) Condition of walls; (3) Aerophagy; (4) Neurosis.

TIME OF VOMITING.—(1) Early morning: especially in alcoholics; much mucus. (2) After meals: at varying intervals. When during or *immediately* after meals, usually neurosis.

CHARACTER OF VOMIT.—Food in various stages of digestion: mucus common. Acids, both character and amount, depend on type of dyspepsia.

Swallowing saliva in excess may induce vomiting, either early morning or after meals: the saliva resulting from dyspepsia, or from catarrh of pharynx.

NAUSEA common.

REGURGITATION OF FOOD.—In small mouthfuls: almost confined to neurotic persons. Usually described as 'incessant vomiting'. May be no wasting. Flatulence usually severe.

Appetite.—See also ANOREXIA NERVOSA.

ORIGIN OF APPETITE.—Depends on: (1) Condition of stomach wall; (2) Gustatory nerves of mouth; (3) Indirectly on the needs of the body, e.g., hypoglycæmia causing gastric peristalsis. Direct cause probably depends on circulation of blood through stomach, with reflexes from distension of lymph spaces.

Dyspepsia—Appetite, continued.

APPETITE IN DYSPEPSIA may be:—

- a. **DEFICIENT.**—From: (i) Diminished circulation in debility. After commencing to eat, may improve from increasing circulation. (ii) Defects of mucous membrane. In chronic gastritis and neoplasm; not in uncomplicated peptic ulcers. (iii) Toxæmic states, especially with furred tongue. (iv) Deficient gastric mobility.
- b. **CRAVING.**—From mild irritation or from motor defects: but small amount of food causes satiation and nausea.

Note.—Appetite good, but satiated by small amount of food, occurs in dilated stomach, and also in hypertrophied stomach with pyloric obstruction.

SPECIAL TYPES.**Disorders of Motor Functions.—****1. HYPERMOTILITY.—**

SYMPTOMS.—Sinking sensation two to three hours after food: satisfied with small amounts of food.

RADIOGRAPH.—No constant appearance in size and shape of stomach. Peristalsis active: empties rapidly. (Usually associated with hyperchlorhydria.)

2. ATONY.—See ATONIC DILATATION OF THE STOMACH, p. 424.**Disorders of Secretory Functions.—****1. HYPERCHLORHYDRIA.—**

MODE OF PRODUCTION OF HYPERCHLORHYDRIA.—Normal pure gastric juice contains about 0.4 per cent HCl: in ordinary test-meal does not exceed 0.2 per cent; with histamine may be 0.3 per cent. Hyperchlorhydria mainly produced by excessive amount of juice and not by increased acidity. Combined acidity low: little mucus.

OCCURRENCE.—(1) Constitutional or functional (may exist without any symptoms). (2) Tobacco. (3) Chronic appendicitis and conditions in lower intestine causing reflex spasm of pylorus. (4) Gall-stones occasionally. (5) Duodenal ulcer.

FUNCTIONAL HYPERCHLORHYDRIA.—Occurs in thin highly-strung or in plump persons. Teeth often good and tongue clean. Three varieties recognized: (1) Digestive: hypersecretion only in response to food. (2) Continuous: resting stomach contains much highly acid juice. (3) Paroxysmal: transient condition in migraine and neuroses.

Symptoms.—(1) Heartburn: high in epigastrium or sub-sternal. (2) Occurs two or three hours after meals, but usually irregularly: eased by food or instantly by alkali. (3) Flatulence slight, unless air-swallower. (4) Acid eructations may occur, and occasionally pyrosis or water-brash. Appetite good. Vomiting absent: may be regurgitation of mouthfuls in nervous subjects.

Physical Signs.—Negative. No muscular spasm.

Radiographs.—Usually rapid-emptying stomach with active peristalsis; but not constant.

2. HYPOCHLORHYDRIA.—

GASTRIC JUICE.—Organic and combined acidity low. Mucus increased. Hypochlorhydria should be confirmed by histamine injections, which cause maximum secretion of which stomach is capable.

OCCURRENCE.—(1) Congenital: complete achlorhydria; may be no symptoms. (2) Carcinoma of stomach. (3) Chronic and acute gastritis, especially in chronic alcoholism. (4) Neuroses. (5) Simple functional diminution of hydrochloric acid: either juice deficient in amount or of low acidity.

Note.—Association of hypochlorhydria and anæmia is discussed under ANÆMIA.

FUNCTIONAL HYPOCHLORHYDRIA.—Usually associated with atony and atonic dilatation (*see* p. 424). Not always so, as stomach may be of normal size, emptying rapidly owing to laxity of pylorus: with tone and peristalsis fair.

Symptoms.—Resemble cases with atony (q.v.), but examination of abdomen may be negative.

Diagnosis.—In hypochlorhydria without dilatation, diagnosis from: (i) Functional hyperchlorhydria, depends on gastric analysis; (ii) Atony of stomach, depends on radiographs.

NOTE: *Histamine Injection for Gastric Juice.*—Dose: 0.1 mgm. per 10 kilos body-weight. Remove gastric juice 10 to 30 minutes later.

Achylia Gastrica.—Diagnosed only by gastric analysis: absence of gastric secretion—(a) no HCl, (b) no ferments. Occurs in: (1) Atrophy of mucous membrane: chronic gastritis, pernicious anæmia. (2) Neurosis: achylia gastrica nervosa. Rare. No characteristic symptoms.

SYMPTOMS with atrophy.—Severe pain, vomiting, and wasting.

If motility of stomach good, symptoms may be slight.

DIAGNOSIS from carcinoma.—(1) Long duration; (2) Complete absence of HCl and ferments, and *very low organic acidity*.

Disorders of Sensory Functions.—These are practically identical with NERVOUS DYSPEPSIA—SENSORY NEUROSES (*see below*).

NERVOUS DYSPEPSIA.

(*Neuroses of the Stomach.*)

Gastric disturbances without gross anatomical changes occurring in persons of nervous temperament or with definite neuroses, e.g., hysteria, neurasthenia. Rare before adult life, and commoner in women. Great care necessary in diagnosis from organic and functional groups: *conditions may coexist.*

CLASSIFICATION.—(1) Motor; (2) Secretory; (3) Sensory. But mixed forms are usual.

Motor Neuroses.—

NERVOUS VOMITING.—Usually neurotic women. Food regurgitates without nausea or retching. Often in mouthfuls. *Time:*

Nervous Dyspepsia—Motor Neuroses, continued.

usually after meals, often immediately follows ingestion. Gastric analysis normal. Progress: (1) No wasting—suggestive of diagnosis; (2) Persistent and occasionally fatal, but recovery usual.

TREATMENT.—Food must be swallowed again. Urge patient to restrain regurgitation. Usually there is much air-swallowing.

NERVOUS FLATULENCE.—(1) Nervous eructations (aerophagia). May be explosive, and duration of several days. Is swallowed air. Hysterical women or occasionally children. Sometimes acquired by observation of others. May be painful distension of stomach, 'pneumatosis', if orifices do not relax. (2) Excessive peristalsis. Borborygmi, gurgling, and consciousness of peristalsis: after meals (often some gastric atony). Intestines also often affected.

TREATMENT.—Weir-Mitchell treatment, if severe. Sedatives. Pressure on epigastrium. (See also FLATULENT DYSPEPSIA, p. 420, and AIR SWALLOWING, p. 412.)

Less important:—

HYPERMOTILITY.—Stomach empties rapidly. Shown by X rays or stomach tube. May occur without symptoms. Often associated with other conditions, e.g., hyperacidity.

MERCYISM OR RUMINATION.—In advanced neuroses and idiots. No affection of health.

Secretory Neuroses.

HYPERCHLORHYDRIA.—Neurotic persons with vague or intermittent symptoms of dyspepsia (or none at all) may have extreme hyperchlorhydria.

GASTROSUCCORRHŒA.—Hypersecretion. Two forms: (1) Intermittent; (2) Continuous. Usually, but not invariably, hyperchlorhydria present.

INTERMITTENT HYPERSECRETION.—Rossbach's 'gastroxynsis'. Onset independent of meals, as at night: epigastric pain, and headache, followed by copious vomiting of acid fluid. Usually severe neurasthenia. Duration, few days. Resembles gastric crises.

CONTINUOUS HYPERSECRETION.—Reichmann's disease. More common. Constant vomiting, with pain and eructations, results in wasting. Dilatation from fluid and pyloric spasm. Condition suggests carcinoma.

Note.—Though rare, cases are met with agreeing with these descriptions, occurring in neurosis, e.g., anxiety neurosis. Great care is necessary in diagnosis. In treatment, attention equally to gastric and neurotic elements.

ACHYLIA GASTRICA NERVOSA.—Hypochlorhydria occurs not very rarely in nervous dyspepsia. Rarely complete absence of HCl and ferments, as in achylia gastrica, but subsequently returning. Symptoms usually severe (see ACHYLIA GASTRICA, p. 415).

Sensory Neuroses.

GASTRALGIA.—All forms of gastric discomfort occur with nervous temperaments, including severe paroxysmal pains. Hyperchlorhydria may coexist.

TYPE OF PATIENT.—(1) Women at menopause, with worry and ill-health; (2) With neurasthenia, anxiety neurosis, and hysteria. Occasionally at puberty.

SYMPTOMS.—In the paroxysmal form, severe epigastric pain radiating to back, onset sudden. No definite relation to food; may occur at night; vomiting uncommon. Food may either ease or aggravate. Pressure usually relieves.

DIAGNOSIS.—Needs great care. Severe paroxysmal pains also occur in: (1) Organic disease of stomach; (2) Referred from other organs, e.g., gall-stone colic, epigastric angina; (3) Gastric crises. In neurosis: (i) General signs of neurosis; (ii) Vomiting infrequent; (iii) Attacks intermittent.

BULIMIA.—Excessive hunger, often suddenly at night. Consumption of food either small or very large; in latter case dilatation occurs. In hysteria and neuroses. Similar attacks in hyperchlorhydria. Also diabetes.

AKORIA.—Constant hunger. Stomach never replete.

ANOREXIA NERVOSA.—*See also* PSYCHONEUROSES—ANOREXIA NERVOSA.

TREATMENT.—Very important; (i) Removal from home (parents often difficult). (ii) Food must not be consciously pressed: increase very slowly. Many months necessary.

General Treatment of Nervous Dyspepsia.—*See* p. 420.

CERTAIN CLINICAL TYPES.

Certain terms are widely, though loosely, in use as applied to dyspepsia. Though included in conditions described above, two of these may be briefly mentioned.

Acid Dyspepsia.—Sometimes applied to conditions with severe heartburn, acid eructations, and possibly pyrosis.

NOTE.—In hypochlorhydria, often great excess of organic acids, and these (e.g., butyric) may be very irritative. Thus, both hypo- and hyperchlorhydria may, and often do, produce similar 'acid' symptoms. Conditions may be susceptible of differentiation only by gastric analysis, radiographs in both showing rapid emptying. (*See* HYPOCHLORHYDRIA, p. 415.)

Flatulent Dyspepsia.—Applied to cases with marked flatulence. Associated specially with hypochlorhydria and increase of organic acid, but also with hyperchlorhydria and normal acidity. (*See* FLATULENCE, p. 412.)

DIAGNOSIS.

Often very difficult. Important to ascertain type of dyspepsia. Consider: (1) Causal factors (*see* GENERAL ETIOLOGY); (2) Symptoms and physical signs; (3) Radiographs; (4) Analysis of gastric contents; (5) Gastroscopy. Diagnosis from:—

ORGANIC DISEASE OF THE STOMACH.—Cancer; ulcer; dilatation.

DISEASES OF OTHER ORGANS.—Gall-bladder; appendix; intestines; liver (cirrhosis); heart.

CONSTITUTIONAL DISEASES.—Especially phthisis.

Dyspepsia, *continued*.

TREATMENT.

General Principles.—(1) Remove cause, if preventable; (2) Diet suitable to condition; (3) Therapeutic and other measures.

Note.—(a) Teeth and constipation are primary considerations treatment; also the encouragement of a good circulation. Neurotic factor common. (c) Avoid all drastic treatment.

REMOVE CAUSE.—In general:—

1. Teeth to be attended to, and general condition of mouth.
2. Mastication to be slow and perfect. Meals at regular hours. Those who dine alone, and no others, should read at meals, to prevent undue rapidity. But, as we are told, "a generous meal consumed with mirth, is better than a physician's prescription in the solitude of the chamber" (Allbutt).
3. Regular exercise. Rest before and after meals. Avoid over-fatigue. Walking home after day's work needs *20 minutes' rest before dinner*.
4. Bowels open regularly. Not occasional purges.
5. Warmth to abdomen and feet. Avoid chill after chief meals.
6. Smoking only after meals, or preferably not at all.

DIET.—Chart of hours and diet essential, noting patient's preferences, and cause and type of dyspepsia.

DIGESTIBLE ARTICLES.—Chicken, mutton, game (comparative^{ly} absence of fibrous tissue). Boiled fish, especially whiting and sole (short muscle fibres). Spinach, asparagus, cauliflower. Farinaceous foods: except as below. Toast.

Minced meat, lightly cooked, is easily digestible. (Vegetable protein needs more pepsin.)

INDIGESTIBLE ARTICLES.—Pork, beef. Twice-cooked or over-cooked meat. Condiments. Fried fish. Cabbages (especially with flatulence). New bread. Brown bread. Short pastry, pies and tarts.

FATS.—Except fresh butter, in strict moderation: no fat foods or fat soups.

SUGAR.—Restricted.

FRUIT.—Stewed fruit good for constipation. Rhubarb, strawberries, and tomatoes contain excess of acid salts.

FARINACEOUS AND PROTEIN FOODS.—Roughly at separate meals, viz., farinaceous at breakfast and tea (times of digestion vary). Avoid tea at protein meals. Chief meal midday or evening, as is most convenient for resting.

FLUIDS.—*At least 2½ pints daily.* Hot water, ½ pint, sipped an hour before meals, including breakfast (and at night); amount during meals diminished. (In atony and dilatation amount of fluid must be diminished especially during meals. But sufficient must be taken daily.)

ALCOHOL.—Allowed sparingly in hypoacidity: not with hypersecretion. Avoid all acid wines. Small amounts of alcohol aid digestion, as seen in 'sherry and bitters' before meals and liqueurs after. To be advised with caution.

MILK DIET.—Strict milk diet rarely indicated; in general not advisable and by no means always well borne. Short period with severe dyspepsia, especially with nephritis and portal obstruction (cirrhosis and heart disease). Diluted preferably. Peptonized if necessary. Definite rules to be laid down: (a) Times: interval 3 hours. (b) Quantity: 3 pints daily. (Contra-indicated in dilatation.) *Watch stools* for undigested curds: if present, reduce milk, and add eggs and toast.

PAPPY SEMI-SOLID STARCH FOODS.—Rarely advisable in any type of dyspepsia, being swallowed with much air without mastication and with consequent loss of salivary digestion.

THERAPEUTIC MEASURES.—(1) Replace deficiencies in gastric juice; (2) Neutralize excesses and give gastric sedatives; (3) Stimulate secretion; (4) Constitutional remedies.

REPLACE DEFICIENCIES.—Specially in atrophy of mucous membrane, and in common mild dyspepsia with suggestion of neurosis. See **HYPOCHLORHYDRIA**, p. 420.

NEUTRALIZE EXCESSES.—See **HYPERCHLORHYDRIA**, below.

STIMULATE SECRETION AND POSSIBLY MOTILITY.—Indicated in hypochlorhydria, in common chronic dyspepsia with flatulence, and in atony.

Bitters: e.g., gentian, quassia, and nux vomica: rhubarb often added.

Alcohol: in small quantities.

CONSTITUTIONAL REMEDIES.—Tonics, iron and quinine.

LAVAGE.—Useful if much pain, vomiting, flatulence, or dilatation, once daily: morning or evening on empty stomach: sod. bicarb. (3j to pint): large amounts until washings are clear. (See **DILATATION OF STOMACH**, p. 426.) Patient easily taught to do this, but often inadvisable if neurotic. Must not be continued for long periods, owing to risk of calcium deficiency.

MASSAGE, ELECTRICITY, HYDROTHERAPY.—With suitable and debilitated cases.

SPAS (e.g., Vichy).—The routine is often valuable, especially in tendency to over-eat. Treatment frequently too drastic if patient is debilitated.

Treatment of Special Types and Symptoms.

Hyperchlorhydria.—Attention to general health, tonics, rest, and change. Salines if constipation.

DIET.—Meat and protein; plenty of fat (inhibits gastric secretion); avoid carbohydrates. No spices, meat, soup, or meat extracts. No alcohol. Salisbury diet useful: meat, half raw, minced (3 to 4 oz. t.d.s.), with stale bread and butter: hot water: butter and cream. Some food to be taken at intervals not exceeding 3 hours.

DRUGS.—

Belladonna, tincture ℥v-x, t.d.s., reduces secretion.

Sedatives before meals, especially if pain is present:—

R	Sod. Brom.	gr. vj	|	Aq. Chloroformi	ad ʒss
	Bismuth. Oxy carb.	gr. x	|		

Dyspepsia—Treatment—Hyperchlorhydria, continued.*Alkalis* after meals (1 hour):—

R	Sod. Bicarb.	} aa gr. xx (in water or milk).
	Bismuth. Oxycarb.	
	Magnesii Carb. Pond.	

Similar fluid prescriptions are efficacious, but have a large deposit, and addition of mucilage causes an unpleasantly thick draught.

Aluminium hydroxide (Alocal) and silicates (Magsorbent) have advantage of not producing gas.

Avoid *bitters* and *acids*.

For *flatulence*: carminatives.

Hypochlorhydria, Flatulent Dyspepsia.—Special attention to teeth, constipation, and general principles of treatment.

DIET.—Give especially soup and meat extracts; minced meat (lightly cooked); fish, eggs, toast, rusks. Meals otherwise dry, to ensure mastication; fluids at end of meals. Avoid fats, except butter in moderation. Diminished farinaceous foods, potatoes, cabbage. No pastry, sugar, or strong tea. Little whisky or brandy allowable.

DRUGS.—

Bitters and alkalis before meals:—

R	Sod. Bicarb.	gr. xx	|	Spir. Chloroformi	℥x
	Tinct. Nuc. Vom.	℥v		Inf. Gent. Co.	ad 3j
	Inf. Rhei	3ij			

(Pot. Brom. gr. x may be added.)

Acids and Ferments, after meals:—

1. *Hydrochloric acid*: acid. hydrochlor. (or nitrohydrochlor.) dil. ℥xxx p.c. with water; repeat in half an hour.
Acidol (Bayer) is a convenient solid preparation.
2. *Digestive Ferments*:—

Pepsin: In tablets gr. v to x, or combined with acid:—

R	Glycer. Pepsini	3j	|	Glycerin.	℥xv
	Acid. Hydrochlor. Dil.	℥xx		Aq.	ad 3ss

Take 15 minutes p.c.

Pancreatin: In tablets with sod. bicarb. 2 hours p.c.

Note.—Alkali and bitters before meals neutralizes organic acidity and improves appetite and digestion. In initial stage of treatment in this group often best to give alkalis after meals as well, as acids increase discomfort; later, with some improvement, give acids.

Carminatives.—Essential oils, e.g., ol. cajuput ℥ij in water; peppermint water, diluted with warm water; or creosote ℥j in capsules. Gentle abdominal massage.

Atony and Dilatation.—See p. 424.

Nervous Dyspepsia.—As a preliminary, look for: (1) Physical and mental strain, e.g., worry, overwork; (2) General neurasthenic and hysterical symptoms; (3) Reflex irritation, e.g., eyes, pelvic and other diseases.

GENERAL PRINCIPLES.—Treat: (1) General condition and constipation. (2) Prominent gastric symptom, e.g., pain, hyperacidity; alleviate as simply as possible (as in *DYSPEPSIA*). Careful consideration of relative importance of general condition and local symptoms. Serious cases with definite neurasthenia often best on *Weir-Mitchell treatment*, with diet of same, and not as suggested by gastric symptoms. Milk diet in general contra-indicated, solids better. Lavage with caution: not to be done by patient. For treatment of special forms, see pp. 416, 417.

Flatulence.—See *FLATULENT DYSPEPSIA*, p. 420; also *AIR SWALLOWING*, pp. 412, 416.

Vomiting.—Usually allayed by treatment of dyspepsia. If severe, morphia or hydrocyanic acid, e.g.,

R	Chloroformi	} aa ℥ij	Glycerin.	℥ss
	Acid. Hydrocyan. Dil.		Aq.	ad ̄ss
	Liq. Morphin. Acetatis			

Lavage, very valuable.

Pain.—Alkalis and general treatment of dyspepsia. Special measures:—

1. Spiritus ætheris (℥ss), with or without spiritus ammoniæ aromaticus (℥ss).
2. Morphia, hydrocyanic acid, chloroform, and bromides. See *VOMITING* above, or following prescriptions:—

R	Liq. Morphin.	} ℥ss	Spir. Ammon. Aromat.	℥ss
	Hydrochlor.		Aq.	ad ̄j
	Spir. Ætheris			

t.d.s.

R	Sod. Brom.	gr. vj	} Acid. Hydrocyan. Dil.	℥ij
	Bismuth. Oxycarb.	gr. x		Aq. Menth. Pip.	ad ̄ss

t.d.s.

3. Lavage.

Constipation.—Salines and aperient waters, senna pods, cascara. Avoid purges. Mercury pill occasionally.

IV. VOMITING.

Vomiting centre is in medulla oblongata, closely associated with respiratory centre.

Process of vomiting.—1st Stage: Profuse salivation and nausea; may 'be cold sweat. 2nd Stage: One or more deep inspirations followed by closure of glottis. Contraction of diaphragm and abdominal walls compresses stomach. 'Retching' results while cardia is closed. 3rd Stage: Ejection of vomitus. First stage may be absent, and entire process effortless.

PATH OF STIMULI.—Fauces and pharynx: by glossopharyngeal nerve. Stomach: by vagus. Certain poisons, e.g., antimony, apomorphine, act directly on vomiting centre.

Causes.—Modes of action overlap and the classification cannot be entirely systematic.

Vomiting—Causes, continued.**ALIMENTARY TRACT.—**

LOCAL REFLEX.—(1) Dyspepsia, gastritis, gastric ulcer, and various gastric conditions. *See* p. 413. (2) Reflex from fauces and pharynx. (3) Œsophageal obstruction.

CENTRAL REFLEX.—Acute abdominal conditions and pain, peritonitis, obstruction, colic. Also testicular trauma.

NERVOUS SYSTEM.—(1) Cerebral lesions: concussion, tumour, meningitis, abscess, etc. Due partly to increased pressure and partly to direct irritation of centre. (2) Tabetic crises. (3) Hysteria. (4) Psychical: smell, sights, and emotions. (5) Ménière's syndrome, sea-sickness (vestibular canals). (6) Migraine (also chemical factors).

TOXIC.—Irritant and emetic drugs. Various modes of action: (1) Direct on vomiting centre, e.g., apomorphine, tobacco. (2) Reflex from stomach, e.g., zinc sulphate, warm water and salt, poison gases. (3) Both actions, e.g., antimony, ipecacuanha.

TOXÆMIC.—Stimulation of vomiting centre or complex action. Nausea marked. Includes: uræmia; pregnancy; acute specific fevers; anæsthetics; acidosis and alkalosis; cyclical vomiting; acute yellow atrophy; Addison's disease; early phthisis.

MECHANICAL.—Severe cough (compression of stomach).

Special Characters.—

SUDDEN ONSET.—Especially important: (1) Acute abdominal disease, e.g., appendicitis; (2) Acute specific fevers; (3) Toxic poisons.

VOMITING IN CHILDREN.—Acute specific fevers. Acute gastritis or gastro-enteritis, acute abdominal disease. Acidosis or cyclical vomiting.

TIME OF VOMITING.—

EARLY MORNING.—(1) Alcohol; (2) Pregnancy; (3) Renal.

AFTER MEALS.—Dyspepsia. Gastric ulcer, from pain during digestion. Neuroses (immediately after ingestion).

NO RELATION TO FOOD.—Dilatation of stomach. Cerebral disease. Gastric crises.

NAUSEA ABSENT.—In cerebral conditions, gastric crises, and neuroses.

BLOOD.—Specially associated with: (1) Gastric ulcer; (2) Cancer. (*See* HÆMATEMESIS, p. 446.)

FÆCAL.—In intestinal obstruction (after stages of, first food, secondly bile): thin fluid. True fæcal masses very rare, and only in hysteria.

NOTE.—In intestinal obstruction, vomit copious and fæcal. In peritonitis, vomit small, not markedly fæcal.

V. CIRRHOSIS OF THE STOMACH.

(*Leather-bottle Stomach. Plastic Linitis.*)

A slow-growing neoplasm of the stomach, mainly affecting the submucosa, and resulting in great thickening of the wall, with reduction of the lumen. Rare.

Note: Is distinct from hypertrophic stenosis of pylorus of children, but a few cases resembling latter are recorded in adults.

Etiology.—Sexes equal. Age, usually 40 to 60.

Morbid Anatomy.—

MACROSCOPIC.—Stomach small and hard. Usually sausage-shaped. No collapse on opening. Lumen holds a few ounces. On section: opaque white. Thickening mostly at pylorus: may be an inch. Coats distinct. Usually limited by pylorus and cardia.

HISTOLOGY.—Thickening mainly due to layer of growth in submucous and, to less degree, in subserous coat. Mucous membrane: often little change, sometimes completely denuded. May be *carcinoma* or *fibroma*. No evidence of inflammation.

Changes usually limited to stomach. Colon, rectum, and ileum sometimes affected. Occasionally grades of chronic peritonitis with adhesions, etc., merging into condition described under **CHRONIC PROLIFERATIVE PERITONITIS**. In other cases, changes localized to near pylorus, with obstruction and dilated fundus.

Pathogenesis.—Disputed whether growth is malignant or benign. No evidence of inflammation, syphilis, tuberculosis, or alcohol. **Note:** (1) Mucosa often unaffected—layers remain distinct; (2) Growth very slow; (3) Symptoms correspond to size and hardness, irrespective of nature of growth; (4) Histology shows (a) majority are carcinoma, (b) some are fibroid. May be accepted that all cases are not of same type: (i) Carcinoma, with special features of slow growth and little infiltration; (ii) Fibromatosis. (For similar difficulties, see **CHRONIC PROLIFERATIVE PERITONITIS** and **HYPERPLASTIC TUBERCULOSIS OF THE ILEOCÆCAL REGION**.)

Symptoms.—Indefinite at onset, vague dyspepsia and anorexia; progress slow, many years. *Anæmia* constant; may be megalocytic. *Vomiting*: at first occasionally; later only small amounts of food retained. *Epigastric pain*: becomes continuous. *Tumour* common: in epigastrium; smooth, firm, round or sausage-shaped, usually movable. *Progressive wasting*, but without malignant cachexia. *Hæmatemesis* unusual. *Gastric analysis*: free HCl usually absent, not invariably.

Radiographs.—Small, horizontal stomach: often empties rapidly (pylorus rigid and incompetent).

Treatment.—Small meals. Occasional lavage. Gastrectomy or gastro-enterostomy if possible.

VI. NON-OBSTRUCTIVE DILATATION OF THE STOMACH.

Groups.—(A) *Gastroptosis*: correctly this is lengthening and not dilatation, and it is considered here for convenience. (B) *Atonic dilatation* of the stomach.

Non-obstructive Dilatation of the Stomach, *continued*.**A. GASTROPTOSIS.**

Pathology.—Gastroptosis is lengthening and not 'dropping' of the stomach, the upper attachment remaining fixed: probably congenital. Neither dilatation nor atony may be present. Visceroptosis sometimes but by no means always coexists.

Symptomatology.—Function may be normal and symptoms absent if: (1) tone normal, (2) pylorus and first part of duodenum not fixed, (3) abdominal muscles efficient.

TONE.—If tone fails, atonic dilatation develops.

PYLORUS AND FIRST PART OF DUODENUM.—Normally movable, and in gastroptosis lower than normal, but if fixed, emptying is impeded and dilatation develops.

Radiographs.—Observe: (1) Long shape and position of stomach; (2) Tone is maintained—shown by barium contents held up to cardiac orifice; (3) Position of pylorus and duodenum; (4) Emptying time not greatly delayed; (5) Contraction of abdominal muscles successful in raising level of greater curvature.

Treatment.—Unnecessary in absence of stasis.

B. ATONIC DILATATION OF THE STOMACH.

NOTE.—Atonic dilatation often but not always coexists with VISCEROPTOSIS (*see* p. 482).

ETIOLOGY.—(1) Physique: often thin with long chest and abdomen as in VISCEROPTOSIS. But may occur with good general physique. (2) Poor general health usually associated with low blood-pressure and poor physique: especially in middle-aged women. (3) Constant overfilling with food or drink. Often with gastroptosis. Uncommon under 40 years.

Normal capacity of average stomach about 35 ounces, maximum about 50 ounces: over 2 pints without inconvenient distension is pathological.

PATHOGENESIS.—Dilatation results from muscular weakness, affecting both tone and peristalsis. When stomach is not emptied by peristalsis, tone attempts to act continuously until exhaustion occurs and stomach commences to dilate. The weaker muscle also results in feebler peristalsis; work is also greater in raising contents to the pylorus if this is fixed. Dilatation thus proceeds.

MORBID ANATOMY.—Muscle wall thin. Chronic gastritis.

SYMPTOMS.—Long duration and gradual onset.

DYSPEPSIA.—Epigastric discomfort and fullness after food: pain unusual.

APPETITE.—Deficient or normal (occasionally sensation of hunger): in latter, rapid satiation after small amounts (pressure rises rapidly in stomach, being already completely relaxed at onset).

FLATULENCE.—Usually marked: much fermentation.

VOMITING.—Uncommon. Occasionally large quantities at infrequent intervals.

General nutrition poor. Skin dry and muddy. Tongue furred. Teeth bad. Constipation usually severe: occasionally diarrhoea. Palpitations. Dyspnoea. *Tetany* (q.v.) is a serious symptom usually due to excessive lavage.

-PHYSICAL SIGNS.—

INSPECTION.—Abdomen: prominent at umbilicus, depressed in epigastrium. (Examine erect.) Divergence of recti muscles common.

Curvatures of Stomach.—Both may be visible, (a) lesser below ensiform, (b) greater below umbilicus.

Peristalsis not visible.

Artificial Inflation.—Tartaric acid \mathfrak{z} j, followed by sod. bicarb. \mathfrak{z} iss, each in half tumbler of water. For inspection and percussion of outline.

PALPATION.—Splashing (*clapotage*) on bimanual examination or shaking patient: no value within two hours of meal: may be auscultated. No rigidity of muscles.

PERCUSSION.—Of little value except after inflation.

GASTRIC ANALYSIS.—Resting contents: may be food residue.

Fractional test-meal: (1) Free HCl: usually present, but nearly always markedly diminished. (2) Total acidity: usually normal or increased, owing to increase of organic acids. Mucus increased. Numerous sarcinæ and bacteria.

RADIOGRAPHS: APPEARANCES AFTER OPAQUE MEAL.—

1. Opacity shaped like a bowl: upper level horizontal, lower crescentic.
2. Lower level several inches below umbilicus: may reach pubes.
3. Peristalsis practically absent.
4. Emptying time prolonged: meal present after 6 hours.
5. Pylorus and duodenal cap not visible or ill-defined.

DIAGNOSIS.—From pyloric obstruction: absence of pain, of symptoms of condition causing obstruction, and of visible peristalsis; radiographs may be indecisive, but evidence of peristalsis usually present in obstruction. Gastroscopy.

TREATMENT.—General health important: rest, exercise, tonics; attention to teeth.

MEALS.—Small, dry, and frequent; at regular hours. Mastication slow. *Rest 20 minutes before*; also, if possible, one hour after (lying on right side).

DIET.—Quantity more important than quality. Ordinary mixed diet: avoid milk puddings, soft and pappy foods, soups.

FLUIDS.—Fluids between meals. Hot water night and morning. *At least 2½ pints of fluid daily.*

DRUGS.—Simple bitter tonic before meals, e.g.—

R Sod. Bicarb.	gr. x	|	Spir. Chloroformis	℥v
Tinct. Nuc. Vom.	℥v	|	Inf. Gentian. Co.	ad \mathfrak{z} ss

After meals: acids, e.g., glyc. pepsinæ co. \mathfrak{z} j and ferments, e.g., taka-diastase gr. v.

Atonic Dilatation of the Stomach—Treatment, continued.

LAVAGE.—Wash stomach once daily for 2 weeks, warm solution of sod. chlor. 3j to pint: pour in two pints, siphon, repeat until fairly clear (about 5 pints). As improvement proceeds, reduce to once a week. (Patient can be taught to do this.)

ABDOMINAL EXERCISES.—(Massage alone is of little use.)

CONSTIPATION.—Correct with abdominal exercises and liquid paraffin, cascara, or senna. Daily motion not essential in early stage of treatment.

ABDOMINAL BELT may assist. Tends to hinder benefits of other treatment.

Surgical operations contra-indicated.

Tetany.—Consider, especially with frequent lavage.

PROGNOSIS.—Comfort obtainable to great extent even after many years on principles of treatment as above: lavage, abdominal exercises, and constipation correctly managed. Prognosis very grave with tetany.

VII. GASTRIC ULCER.

Loss of tissue in the mucous membrane and deeper coats of the stomach, characterized clinically by epigastric pain related to food, vomiting, and hæmatemesis. Ulcers may be acute or chronic, the incidence and other factors varying considerably in the two forms.

Acute and Chronic Ulcers.—A short duration of symptoms does not prove that an ulcer is 'acute' pathologically—i.e., of short duration—as a chronic ulcer may be completely latent. 'Acute' and 'chronic' in this chapter apply to pathological characters and not to length of history.

ETIOLOGY.

Age, Sex.—(1) *Acute ulcers*: Mainly in young females, age 20 to 30 years. Now rare. (2) *Chronic ulcers*: Sexes equal; but in females onset rare after 50 years, in males not uncommon.

Heredity.—Not uncommonly familial. May be special tendency to hæmorrhage, or occasionally to perforation.

Various.—*Diet*: no obvious influence. *Tobacco*: disputed. *Alcohol*: not a factor (possibly with cirrhosis of liver). Syphilis, tuberculosis: no influence.

PATHOGENESIS.

Cause of formation of peptic ulcers is unknown. Invariably associated with presence of: (1) Gastric juice; hyperchlorhydria not necessary. (2) Gastric or duodenal mucous membrane; cf. ulceration in mucous membrane in Meckel's diverticulum and lower end of œsophagus.

Factors may be: (1) Trauma—i.e., abrasions during digestion. (2) Chronic hypertrophic gastritis. (3) Sepsis—e.g., from mouth, gall-bladder, appendix. (4) Lesions of hypothalamic region (diencephalon), gastric ulcer developing after certain operations and experiments.

Acute gastric ulcers usually heal rapidly; unknown why they sometimes become chronic. Experimental ulcers in animals heal rapidly unless acidity of gastric juice is artificially raised.

MORBID ANATOMY.

Acute Ulcers.—Not uncommonly multiple (nearly half). *Site*: any position from cardia to pylorus, usually lesser curvature, commoner on anterior than posterior wall. *Size*: between a pea and a shilling. *Appearance*: small, punched-out ulcer; edges clean-cut; floor smooth; base formed by submucous, muscular, or deeper layers; walls terraced, each layer being less affected than the next superficial; no œdema or surrounding inflammation. Peritoneal surface usually not thickened. *Appearance during life*: œdema and congestion in neighbourhood; appears more ragged; often fibrinous deposit on peritoneal surface. Hæmorrhage rarely fatal. Perforation frequently results in general peritonitis, from absence of adhesions.

Chronic Ulcer.—Rarely multiple. *Site*: near pylorus, on lesser curvature, posterior surface: over 80 per cent. *Size*: may cover several inches. *Appearance*: affected by fibrosis and contraction; edges raised, may be overhanging; wall irregular and indurated; floor smooth or scarred, formed by deeper layers or by another adherent organ, e.g., pancreas. Inflammatory changes in neighbourhood.

An acute and a chronic ulcer may be present simultaneously.

Mode of Healing.—Granulation tissue spreads in from edge. Acute ulcers heal with little scarring or sequelæ. Chronic ulcers after years may show no healing, or extend in one part while scarred in another. Fibrosis of large ulcer may produce serious results: (1) Pyloric stenosis; (2) Hour-glass stomach, from saddle-ulcer involving anterior surface.

Healed Ulcers.—Autopsies prove that ulcers of any size or depth may heal completely.

Erosions.—Small abrasions or slits in the mucosa, usually multiple; due to chronic hypertrophic gastritis. Occasionally cause severe hæmorrhage (Hale White's 'gastrostaxis').

SYMPTOMS.

Characteristic Symptoms.—(1) Pain in epigastrium definitely related to food; (2) Epigastric tenderness; (3) Muscular rigidity; (4) Vomiting; (5) Hæmatemesis and occult blood.

MODE OF ONSET.—Types:—

1. Latent. First symptom hæmatemesis or even perforation.
2. Insidious. Symptoms at first indefinite and occasional, becoming more characteristic.
3. Atypical. Ulcer revealed by radiographs.

PAIN.—Rarely absent.

SITE.—*Epigastrium*, frequently just below ensiform: usually localized. Also occurs in back, at tenth dorsal vertebra:

Gastric Ulcer—Symptoms, *continued*.

pain may shoot through, or spread round left side. In adherent ulcers, often lower in epigastrium and more diffuse. **FOLLOWS, OR AGGRAVATED BY, FOOD.**—Recurring fairly regularly one-quarter to two hours after meal. Not so consistent as in duodenal ulcer. Worse after solids. Relieved by period on milk diet.

DURATION.—Varies: often one hour, eased by alkalis or vomiting, but not completely by food. Is not continuous, though in severe cases discomfort may be persistent. In early stages not severe. May be burning, or heavy, or in severe paroxysms. May be freedom for long periods and then recurrence.

EPIGASTRIC TENDERNESS.—

DEEP TENDERNESS.—On deep palpation in epigastrium: area small, about 1 inch: site is constant. Most marked when also pain. Tenderness at angle of left scapula uncommon.

SUPERFICIAL TENDERNESS.—Hyperæsthesia of skin rare. Area small, $\frac{1}{2}$ to 1 inch, sharply defined, usually near left costal margin: rarely also area near spine, 7th to 11th dorsal, on left.

SITE OF ULCER AND RELATION TO PAIN AND TENDERNESS.—*Deep tenderness* is over position of ulcer (as shown by radiographs). Site of *pain* not necessarily identical and little guide. Time of pain: (1) Ulcer of cardia: pain directly on eating. (2) Ulcer at pylorus: interval 2 hours or so. (May be definite 'hunger pain'.)

ORIGIN OF PAIN.—Uncertain: possibly abnormal peristalsis: not due to irritation of nerves in ulcer. Hyperæsthesia is 'reflected' pain, a viscerosensory reflex.

MUSCULAR RIGIDITY.—Recti muscles may be contracted, both or one or part of one. Is proof of inflammatory lesion when definite. May persist after pain and tenderness disappear (during treatment).

VOMITING.—Common but not invariable. Usually at height of pain, giving relief. Quantity small, acid fluid with partially digested food. Frequent and early with cardiac ulcer. Bile rare.

HÆMATEMESIS.—See p. 434.

Various.—

APPETITE.—Often good, but 'afraid to eat'.

TONGUE.—Clean.

TEETH.—Frequently carious, but may be very good.

DYSPEPSIA.—Flatulence, etc., common, especially in chronic ulcers. Severity of all degrees.

CONSTIPATION.—Rarely absent.

ANÆMIA.—May be microcytic anæmia, depending on hæmorrhages and diet.

NUTRITION.—Usually good. In chronic ulcers, may be wasting from limitation of diet.

Physical Signs.—Examine for deep and superficial tenderness and muscular rigidity. Also for gastric peristalsis, splash, and tumour.

Occult Blood in Fæces.—Frequently present. (Disappears under treatment.)

Gastric Analysis.—Often of little assistance. Acidity usually at higher limits of normal, but hyperchlorhydria commoner than in normal subjects. In very chronic cases may be hypochlorhydria or achlorhydria, especially in resting juice; attributed to chronic gastritis: HCl may rise after treatment. Blood may be present.

Radiographs.—With opaque meal. Nearly always diagnostic in chronic ulcers.

1. 'Niche'. Barium enters and is retained in lumen of ulcer; appears as protrusion or 'crater' on outline. Is larger than true size of ulcer owing to œdema and heaping up of mucous membrane round ulcer.

Healing Ulcer.—Crater often becomes cone-shaped.

2. Incisura. Depression due to spasmodic contraction of wall opposite to ulcer. If persistent, not relaxing with massage, repeat later after atropine.

3. Stomach tends to empty slowly.

Note.—Absence of irregular area of 'filling defect' found with neoplasms.

Gastroscopy.—Chronic ulcers often identifiable.

COMPLICATIONS AND SEQUELÆ.

SUMMARY.—(1) Hæmatemesis (pp. 434 and 446); (2) Perforation; (3) Carcinoma (p. 440); (4) Results of healing ulcer; (5) Pyloric obstruction; (6) Hour-glass stomach; (7) Perigastric adhesions; (8) Jejunal ulcer (p. 434).

Perforation.—

MORBID ANATOMY.—*Site*: on anterior wall in 70 per cent. More frequent in acute ulcers (from mobility of stomach and absence of adhesions); hence total incidence greater in women; but of perforated chronic ulcers, over age of 30, more occur in men. May be multiple. *Results* depend on site, size of perforation, and adhesions: (1) Generalized peritonitis, especially from anterior wall and acute ulcers; (2) Localized abscess—e.g., chronic ulcer ruptures into lesser sac, and produces subphrenic abscess; uncommon. Very rarely, perforates into adherent intestine, usually into the transverse colon. Very rarely into pleura or pericardium.

SYMPTOMS.—May be no previous gastric symptoms, especially in acute but also in chronic ulcers. With perforation, sudden onset of severe continuous pain, commences in epigastrium, spreads over abdomen. Vomiting not invariable. Shock: variable. Pulse may be strong; temperature subnormal. *Progress*: general peritonitis: may be free gas present.

Gastric Ulcer—Complications and Sequelæ, continued.

LATENT PERIOD.—Immediate symptoms of peritonism may subside in half to one hour, and a period follows in which no signs or symptoms are present. Duration, few hours. Then general peritonitis develops.

TREATMENT.—Immediate operation. Results improving.

LOCAL OR SUBPHRENIC ABSCESS.—Initial symptoms as above. Temporary improvement. Symptoms of sepsis develop. Abscess may give physical signs (*see* SUBPHRENIC ABSCESS).

Results of Healing Ulcer.—Acute ulcers leave no sign, or small harmless scars. Chronic ulcers may produce: (a) Pyloric obstruction; (b) Hour-glass stomach; (c) Perigastric adhesions.

Pyloric Obstruction.—May result from: (a) Contraction of scar; is permanent; not common from gastric ulcer. (b) Spasm or œdema of mucous membrane near juxta-pyloric ulcer; obstruction may be temporary, but often becomes permanent later. *See* p. 443.

Hour-Glass Stomach.—Now rare. Almost confined to women. Does not develop after treatment of ulcer.

MORBID ANATOMY.—Stomach divided into two pouches by fibrous constriction due to ulcer usually on lesser curvature and involving anterior surface. Orifice may admit a pencil only, but is often larger than radiograph suggests. Pyloric stenosis often coexists.

SYMPTOMS.—Not characteristic: resemble pyloric stenosis or gastric ulcer, but vomit small and peristalsis unusual. *Previous symptoms:* Indefinite dyspepsia for many years.

TREATMENT.—Operation: gastrectomy or anastomosis between portions.

DIAGNOSIS.—By radiographs; active ulcer crater may also be present. Constrictions in body of stomach may also occur in:—

1. Neoplasms.
2. Gastropptosis: *in erect posture* drag may divide stomach into two parts. Similarly in atonic dilatation.
3. Spasm: associated with gastric or duodenal ulcer, or no obvious cause.

'*Cup-and-Spill*' or '*Cascade*' Stomach.—Upper part of stomach forms a cup, which fills first and then 'spills' over into lower part. May be ulcer or transitory spasm.

Perigastric Adhesions.—In chronic ulcers very frequent, especially on posterior surface or near pylorus; tend to prevent healing, but diminish risk of perforative peritonitis.

VISCERA INVOLVED.—(1) Pancreas, 50 per cent of adhesions; (2) Liver, 25 per cent; (3) Less often colon, spleen, mesenter, etc. (Gastric adhesions also occur in disease of gall-bladder, pancreas, syphilitic liver, and may be extensive in chronic peritonitis.)

RESULTS OF ADHESIONS.—May be impaired motility, pyloric obstruction, hypertrophy of stomach. Rarely, chronic plastic peritonitis present.

SYMPTOMS.—Often indefinite. Pain: frequent, influenced by posture, relieved on lying down, increased by pressure, less affected by diet and less intermittent than in gastric ulcer. In pancreatic adhesion, pain often severe in back.

RADIOGRAPHS: APPEARANCE AFTER OPAQUE MEAL.—
(1) 'Shadow defects'; (2) Interference with peristaltic waves.
(See CANCER OF THE STOMACH, p. 441.)

DIAGNOSIS.

Simple with hæmatemesis and characteristic symptoms, namely:
(1) Pain localized, related to food, eased by alkalis or vomiting;
(2) Deep localized tenderness; (3) Muscular rigidity; (4) Occult blood. Radiographs and gastroscopy usually decisive. For hæmatemesis, see p. 446.

Acute Ulcer.—Note: Short history does not exclude chronic ulcer.

Chronic Ulcer.—Diagnosis from:—

1. **CHRONIC GASTRITIS.**—Often difficult. Discomfort less related to food. No localized tenderness or rigidity.
2. **CANCER.**—Pain more continuous; rapid wasting; may be tumour. Gastric analysis: (i) If short history, free HCl absent (important); (ii) If long history, may be cancer following ulcer, acidity as in gastric ulcer. (See CANCER OF THE STOMACH, p. 438.)
3. **DUODENAL ULCER.**—Pain relieved by food, vomiting slight.
4. **GALL-BLADDER DISEASE.**—Radiation of pain. Gastric analysis: free HCl usually lessened or absent.
5. **CHRONIC APPENDICITIS.**—Gastric symptoms may simulate an anomalous ulcer, but relation of pain to food irregular, and no definite rigidity of recti. Alkalis ineffectual.
6. **GASTRIC CRISIS (TABES).**—Pain and vomiting independent of food. Larger area of cutaneous hyperæsthesia (may precede loss of knee-jerks and Argyll Robertson pupil).
7. **CIRRHOSIS OF THE LIVER.**—Often difficult in alcoholics. May coexist. Difficulty is to exclude ulcer.

TREATMENT.

General Principles of Medical Treatment.—(1) *Rest for stomach and ulcer*, obtained by: (a) Rest in bed. (b) Food non-irritating but sufficient. (2) *Prevent irritation of ulcer by acid gastric juice* (free HCl delays healing, though not necessarily cause of ulcer formation): control of free HCl needs treatment every hour by (a) food every 2 hours, (b) alkalis alternate 2 hours; also (c) methods to reduce acidity, e.g., atropine, olive oil.

DURATION OF TREATMENT.—(1) Strict régime: four weeks (or longer if symptoms persist). (2) Convalescent régime: about three weeks. (3) Gradual return to full occupation: three weeks.

Gastric Ulcer—General Principles of Medical Treatment, *continued*.

PAIN.—Often disappears in few days: is evidence of commencement but not of completion of healing. Persistence under treatment may be due to: (a) severe ulceration, (b) ulcer adherent, (c) neurosis, (d) pyloric spasm.

Radiographs.—Barium meal not to be given while pain persists, or for at least 4 weeks after hæmatemesis.

System of Medical Treatment.—

1. **REST IN BED**.—Four weeks or longer if necessary. Pain, deep and superficial tenderness and muscular rigidity, and occult blood must be absent before patient is allowed up.
2. **DIET**.—Feeds must be: (1) Given every 2 hours during day—also one or two at night; (2) Small amount; (3) Easily digestible; (4) Liquid. Commence with milk (add sodium citrate gr. x to pint).

FIRST WEEK.—Milk, 5- to 7-ounce feeds: total about 3 pints. Flavour with tea or coffee.

SECOND WEEK.—Add gradually 2 to 3 eggs, toast and butter, cream. Arrowroot, ovaltine, Horlick's, etc., may be substituted for 2 or 3 milk feeds.

THIRD AND FOURTH WEEK.—Steamed fish, milk puddings, jelly, etc., gradually added and substituted for certain milk feeds.

FOURTH TO SIXTH WEEK.—Gradual progress to convalescent diet.

Note: Meulengracht's diet, *see* p. 436, also gives satisfactory results.

FLUID.—Additional fluid as desired, e.g., barley water and glucose.

VITAMINS.—Diet is deficient in vitamins, especially C. Give orange juice or vitamin C.

3. DRUGS.—

a. ALKALIS.—

R	Bismuthi Oxycarb.	} aa
	Mag. Carb. Pond.	
	Sod. Bicarb.	
		} aeq. par.

One teaspoonful between six meals for first two weeks: reduce to three doses daily by end of fourth week. Two teaspoonfuls at bedtime.

During Night.—In early stages, two doses at night (with light feeds). Later, one dose and feed. Increase dosage if patient wakes with discomfort.

Alternative Alkalis.—Mag. carb. in above powder may cause diarrhoea and need reduction. Creta prep. may be substituted for sod. bicarb. Carbonates produce gas and gastric distension: *magnesium trisilicate* avoids this and also neutralizes more acid; dose ʒss and ʒj, at bedtime; also less risk of alkalosis.

Alkalosis.—Rare. Onset usually about end of first week. Specially liable to occur with pyloric obstruction. *See* p. 357. *Treatment*: Omit alkalis.

- b. OLIVE OIL, $\frac{3}{4}$ ss, immediately before three meals. TINCT. BELLADONNÆ, \mathbb{M} 5 to 10, before remaining meals in early stages. Later, arrange to alternate.

General and other Treatment.—

- BOWELS.—Treat with cream of magnesia.
 ICE-BAG TO EPIGASTRIUM.—If much tenderness or pain. (Must be carefully supported from above.)
 TOBACCO.—No smoking during course.
 TEETH.—Remove *septic teeth* (not during strict treatment).

Other Methods of Treatment.—

- MEULENGRACHT'S DIET.—See p. 436. Has advantage of ample diet, many ulcer diets involving partial starvation.
 HISTIDINE INJECTIONS.—Probably psychological effect only.

Permanent Regulations.—

1. DIET.—Interval between food not more than 3 hours. Three ordinary meals, with snacks (milk, cake, sandwich) mid-morning, teatime, and bedtime. Ordinary mixed diet, but in general avoid: tough meat; uncooked hard vegetables and fruits, skins and pips; condiments and spices; new bread. Regular hours for food. Masticate slowly.
2. ALKALIS.—Continue t.d.s. and at night for six to twelve months with occasional intervals and gradual reduction. Subsequently for occasional periods and on any discomfort.
3. TOBACCO.—Preferably none, or only following meals.
4. ALCOHOL.—No short drinks before meals.

Prognosis and Failures under Medical Treatment.—

1. IMMEDIATE RESULTS.—Usually good if treatment adhered to.
2. RELAPSES.—Considerable tendency under all forms of treatment. Full period of treatment and permanent regulations often not adhered to at first experience; after one relapse, stricter treatment often gives better results, and a second course may be satisfactory after first failure. Many so-called 'courses of medical treatment' of little value.
3. RELAPSES AND FAILURES UNDER STRICT TREATMENT.—Operation to be considered with circumstances of each patient. Cases so failing under medical treatment also often relapse after operation.

Statistics show that immediate results and relapses are closely similar for medical and surgical treatment, excluding direct and indirect risks from operation.

4. ADHESIONS.—If severe, hinder medical treatment and render operation difficult.
 5. PYLORIC OBSTRUCTION.—If due to spasm from juxta-pyloric ulcer, may be partially amenable to medical treatment needs longer duration.
- HÆMATEMESIS.—See p. 434.

Gastric Ulcer—Treatment, *continued*.

General Results of Surgical Treatment.—

1. Immediate good results and period of freedom better than medical treatment.
2. Relapses more frequent and difficult to treat.
3. Immediate mortality: about 10 per cent.
4. Gastrojejunal ulcer: sequel in about 4 per cent. Marked hyperchlorhydria is contra-indication to gastro-enterostomy.

Special Indications for Operation.—

1. Perforation.
2. Hour-glass stomach.
3. Pyloric obstruction.
4. Suspicion of cancer. Diagnosis now accurate, but consider in doubtful cases.

GASTROJEJUNAL AND JEJUNAL ULCERS.

Serious sequel of gastrojejunostomy for peptic ulcer. Development depends on presence of HCl in gastric contents.

Incidence.—After duodenal ulcer, about 10 per cent; gastric ulcer, 4 per cent; carcinoma, nil.

Time of Onset.—About 20 per cent shortly after operation; about 60 per cent within 2 years; no upper limit.

Symptoms.—(1) *Pain*: suggestive of ulcer but follows food shortly, and often towards left epigastrium. (2) *Occult blood*. (3) *Hæmatemesis*. (4) *Perforation*. (5) Gastro-jejuno-colic fistula: diarrhoea, fæcal vomiting, wasting; rare. *Radiographs*: niche rarely recognizable.

Treatment.—Medical: prolonged. Surgical: high mortality; gastrectomy preferable, or restore anatomy.

Prognosis.—Poor.

HÆMORRHAGE DUE TO PEPTIC ULCERS.

Incidence.—Hæmorrhage occurs in about 25 per cent of ulcers: mostly as unimportant incident. Mortality from hæmorrhage of all peptic ulcers, 1 to 2 per cent.

Acute and Chronic Ulcers.—Hæmorrhage more serious from pathological chronic ulcers: larger vessels opened and healing slower than acute ulcers. *Note*: Is no assistance as guide to treatment: distinction impossible on length of history, since: (a) with short or no previous history, chronic ulcer often present; (b) with long history and known chronic ulcer, hæmorrhage may come from recent acute ulcer. Radiography dangerous within 4 weeks of hæmorrhage.

Site of Ulcers in Hæmorrhages.—

ACUTE GASTRIC ULCER.—Often on lesser curvature; hæmorrhage from branches of coronary or gastro-epiploic arteries.

CHRONIC GASTRIC ULCER.—Posterior surface; from splenic artery.

DUODENAL ULCER.—Posterior wall; from superior pancreaticoduodenal and gastro-duodenal arteries.

Acute Hæmorrhage.—Of clinical importance only when sufficient to be presenting (not necessarily initial) symptom for treatment. Mortality in such cases, 15 to 20 per cent.

TWO GROUPS.—Distinction usually simple.

1. **MODERATE.**—Clinical state not serious. Mortality low: second hæmorrhages unusual. Treatment: medical.
2. **GRAVE.**—Clinical state serious.

'Grave' Hæmorrhage.—Includes cases:—

- a. With serious accessory medical factor, e.g., nephritis. Accounts for majority of fatalities. Mortality very high. No treatment effective.
- b. Clinical state solely due to hæmorrhage. Usually large artery opened, but occasionally erosions only. Rare, but high mortality. Accounts for mortality of 5 to 8 per cent in cases presenting for hæmorrhage. Treatment: operation to be considered.

'Criterion of 'Grave' State.—Restless, slow cerebration, condition clinically serious. Hæmoglobin usually under 30 per cent.

Note.—*Hæmoglobin*: does not fall immediately after hæmorrhage: repeated estimations show progressive fall. Estimation of blood volume and of cell volume is guide to extent, persistence, and recurrence of hæmorrhage.

Pulse-rate. Blood-pressure.—Unreliable.

Indications for Treatment.—

SURGICAL TREATMENT.—Consider in 'grave' cases with no medical complications. Length of history is no guide. Object of operation to check bleeding point: often impracticable and mortality unavoidably high. Cases rare.

NOTE.—Operation for acute hæmorrhage is only indicated as urgent procedure to check bleeding point: not indicated after hæmorrhage has ceased.

MEDICAL TREATMENT.—All other cases. Mortality low: always less than operation except as above.

Medical Treatment.—

1. **MORPHIA.**—Injection of morphine hydrochloride gr. $\frac{1}{4}$ to $\frac{1}{2}$ immediately.
2. **DIET.**—For first 24 hours: fluid only in sips. Feeding commences on second day: milk feeds as for ulcer in half quantities, increasing daily, or Meulengracht's diet. More prolonged starvation inadvisable.
3. **ALKALIS.**—From onset, as for ulcer: magnesium trisilicate preferable.
4. **FLUIDS.**—Must not remain thirsty: frequent sips of water given from onset, increasing in amount; rectal saline. **Note:** Dehydration associated with rise of blood-urea to 100 or 150 mgm.

Gastric Ulcer—Medical Treatment, continued.

MEULENGRACHT'S DIET.—Commence on second day. Full *purée* diet—e.g., meat balls, omelette, fish balls, various gratins and *purées*, mashed potatoes, vegetable soups: six meals daily. Amount as desired. Many observers have good results; *moderation* for first few days. *Alkalis* given.

VARIOUS MEASURES.—

MOUTH.—Carefully cleansed.

BOWELS.—Enema on second day.

EVACUATION OF BLOOD.—Wash stomach with cold water, empty with Senoran's aspirator (with caution).

Hæmostatics, injection of adrenalin: valueless.

Note.—Snake venom under investigation.

BLOOD TRANSFUSION.—Indicated if hæmoglobin below 50 per cent. Inject 600 c.c.: rise of blood-pressure little risk. Continuous drip method well employed. Transfusion in all surgical cases.

Chronic Cases with Repeated Hæmorrhages.—Decision as to operation based on circumstances of each case. *Note*:—

1. Fatalities very rare.

2. Repeated hæmorrhages at intervals after strict medical treatment sometimes but not always cease after operation. Recurrences may be erosions of chronic gastritis or formation of fresh ulcers.

Results of medical and surgical treatment about equal.

VIII. DUODENAL ULCER.

Loss of tissue in the mucous and deeper coats of the duodenum, characterized clinically by epigastric pain eased by taking food, by *melæna*, and by high gastric acidity.

Etiology and Morbid Anatomy.—

SEX.—Great majority in males.

AGE.—Usually over 30 years.

SITUATION OF ULCER.—In first part of duodenum in 80 to 90 per cent, usually within one inch of pylorus, never below biliary papilla. Generally on upper portion of anterior wall.

Occasionally difficult to decide if ulcer is pyloric or duodenal; Mayo gives pyloric vein as line of demarcation (but position not constant).

NUMBER.—Usually single. Multiple rare.

BURNS.—Rare sequel of burns, usually extensive. Not of practical importance. Cause unknown, possibly septic emboli.

Characteristic Symptoms.—(1) 'Hunger pain'; (2) *Melæna*; (3) *Hyperchlorhydria*.

MODE OF ONSET.—*Insidious* usually. Periods of dyspepsia gradually assuming characteristic features, occurring over years for 2 or 3 weeks with long intervals which gradually shorten. Worry, exhaustion, large meal or over-smoking may cause attack. Especially in spring and autumn. *Latent* more rare: hæmorrhage or perforation initial symptom.

PAIN.—

CHARACTERS: (1) *Occurrence when stomach empty*, viz. 2 to 4 hours after food, or often at night—i.e., 'hunger pain', often described as "sinking sensation"; (2) *Regular and punctual*; (3) *Eased by food or alkali*, not eased by vomiting.

SITE.—To right of epigastrium, and above umbilicus. Radiates to epigastrium, umbilicus, and right side, rarely to subscapular region. Occasionally the pain is in centre or even to left of epigastrium.

DEEP TENDERNESS.—On deep palpation over site of ulcer.

Superficial tenderness may be present: does not localize ulcer.

MUSCULAR RIGIDITY.—Site varies: often over active ulcers.

HÆMORRHAGE: MELÆNA.—Slight or severe, often repeated. Rapid fatality rare. On occurrence, faintness, cold sweat, and rapid pulse if severe. On passage of melæna, some colicky pain, sudden call to stool, and passage of 'tarry motions'. Both the melæna and occurrence of bleeding may be unrecognized by patient. See pp. 434 and 446.

OCCULT BLOOD.—Commonly present.

Hæmatemesis may also occur, depending on site of ulcer; rarely without melæna.

VOMITING.—Uncommon. Suggests obstruction.

VARIOUS.—

APPETITE.—Good. Often 'afraid to eat'.

TEETH.—Vary. Sometimes very good.

WASTING.—Uncommon.

CONSTIPATION.—Usual.

HEARTBURN.—Frequent. PYROSIS not uncommon.

ANÆMIA.—Depends on hæmorrhage. Occasionally extreme even in absence of gross melæna. Facies pale with yellow tinge.

Gastric Analysis.—Hyperchlorhydria characteristically present.

Resting juice: amount increased, 50 to 150 c.c.; acidity moderate to high. *Fractional test-meal*: 'Climbing curve' to high level, maximum may be 0.35 gm. HCl per cent; starch absent in 1 to 1½ hours, i.e., stomach empty, subsequently clear fluid; total acidity about 0.04 above free HCl. *With histamine injection*: rise more rapid and higher, maximum may be 0.40 gm. HCl. No mucus.

With obstruction: High acidity in resting juice. May be delay before free HCl rises, but finally reaches high level. Total acidity may be 0.10 above free HCl.

Radiographs: Appearances after Opaque Meal.—

1. Stomach normal in shape, but peristalsis active and organ empties very rapidly, often in one hour.
2. Duodenal cap irregular in outline. If tender to palpation, is evidence of active ulcer. If not tender, may be scarring of healed ulcer. Niche of active ulcer crater difficult to recognize. Irregularity of cap also occurs from adhesions to gall-bladder, etc., or from transient spasm, with cholecystitis, appendicitis, or colitis.

Duodenal Ulcer, continued.

Complications and Sequelæ.—Resemble those in gastric ulcer, except that carcinoma is practically unknown.

HÆMORRHAGE.—See p. 434.

PERFORATION.—Especially with ulcers on anterior wall. Peritonitis results as in perforated gastric ulcer, but may be pain in right epigastrium. May simulate perforation of appendix.

PYLORIC OBSTRUCTION.—Ulcers near pylorus may cause pyloric obstruction by scarring or spasm.

ADHESIONS.—To liver, gall-bladder, or pancreas.

GASTROJEJUNAL AND JEJUNAL ULCER.—See p. 434.

Diagnosis.—Simple if characteristic symptoms present. Often difficult. From:—

GALL-BLADDER DISEASES.—Resemblance may be close, but pain radiates to right shoulder; gall-bladder tender; no melæna.

GASTRIC ULCER.—Character of pain; frequency of vomiting.

GASTRIC CRISES (TABES).—Pain and vomiting independent of food. Larger area of cutaneous hyperæsthesia.

Note.—Gastric crises may occur before loss of knee-jerks and Argyll Robertson pupil.

APPENDICITIS.

Treatment, General Prognosis.—See GASTRIC ULCER.

General Results of Surgical Treatment.—

1. Immediate results and period of freedom good in 50 per cent; better than medical results.
2. Relapses frequent after 5 years.
3. Immediate mortality of operation; about 5 per cent.
4. Gastrojejunal ulcer: incidence after gastrojejunostomy about 10 per cent. Prognosis serious.

IX. CANCER OF THE STOMACH.

Etiology.—

INCIDENCE.—In males, most frequent form of cancer. In females, less common than uterus and breast. Accounts for 20 to 40 per cent of cancer cases, and 1.5 to 3 per cent of all deaths.

SEX.—More frequent in males. Statistics vary, possibly 2 to 1.

AGE.—Commonest between 40 and 60 years. Rare under 30 years.

Pathogenesis.—

IRRITATION.—Predominance at certain sites ascribed to exposure to local irritation.

CHRONIC GASTRITIS.—Achlorhydria always precedes and is not result of carcinoma. Certain authorities believe that carcinoma is always preceded and excited by chronic atrophic gastritis: reasonable but unproved. (Gastric ulcer type not here referred to.)

RELATION TO GASTRIC ULCER.—See p. 440.

External trauma, alcohol, tuberculosis: of no influence. Heredity; data very incomplete, no proof of influence.

General Features of Morbid Anatomy.—

FREQUENCY AT DIFFERENT SITES.—(1) Pylorus, 60 per cent; (2) Lesser curvature, 10 to 15 per cent; (3) Cardia, 8 to 10 per cent; (4) Posterior wall, 5 per cent; (5) Whole, or extensive, 5 per cent. Anterior wall, greater curvature, fundus: rare.

MACROSCOPIC APPEARANCE.—(a) Frequently an ulcer with rough floor and hard, irregular, everted edges, wall thick and adherent; (b) May be fungating masses. Hard and soft areas often coexist.

Early malignant ulcer distinguished from innocent often by microscopic sections only.

Spreads in submucous coat; on section the white translucent growth shows against dark, hypertrophied muscle; may be $\frac{1}{2}$ inch thick. Spread is by lymphatics.

PYLORIC CANCER.—Characteristics: (1) Walls thickened; (2) Opening narrowed; (3) *Pyloric sphincter everted* into duodenum; (4) *Duodenum never involved*. Usually scirrhus. Tends to spread along lesser curvature. May be pyloric obstruction.

'LEATHER-BOTTLE' STOMACH.—See CIRRHOSIS OF THE STOMACH, p. 422.

Note.—Duodenum never invaded, but gastric neoplasm may involve cardiac orifice.

Morbid Histology.—Four types of carcinoma: (i) Scirrhus, 75 per cent; (ii) Encephaloid; (iii) Columnar-celled; (iv) Colloid. Transition and mixed forms are common. May be grouped as:—

1. SPHEROIDAL-CELLED CARCINOMA.—

a. **SCIRRHUS.**—Common at pylorus. Very hard, whitish, little juice on scraping. *Histology*: much stroma, few cells.

b. **ENCEPHALOID OR MEDULLARY.**—Soft masses, grayish white, much juice. Ulceration and hæmorrhage common. May coexist with scirrhus. *Histology*: masses of cells, stroma scanty.

2. COLUMNAR-CELLED ADENOCARCINOMA.—Large masses moderately firm. May fungate. *Ulcer* not uncommon, and microscopically carcinoma often recognizable only at edge of ulcer. *Colloid degeneration* not infrequent. Tendency to secondary growths in glands, liver, lungs, and bones.

3. COLLOID CARCINOMA.—Colloid degeneration is common. Spreads widely. *Often extends to omentum* and neighbouring organs. Forms large masses. *Histology*: alveoli very distinct, containing glistening colloid material and often a few large epithelial cells. *Substance differs from thyroid secretion*.

Resultant Changes in the Stomach.—Vary with site of tumour:

(1) Cardia: stomach small, œsophagus dilated. (2) Pylorus: stomach usually dilated (see PYLORIC OBSTRUCTION, p. 443). (3) Body: little change.

Adhesions common, especially to pancreas, liver, and colon. In absence of adhesions, stomach often very mobile, owing to weight of tumour.

Cancer of the Stomach, continued.**Secondary Growths.**—Very common : in over 80 per cent at death.**LYMPHATIC GLANDS.**—In 35 per cent at least. (1) Abdominal, frequently. (2) *Cervical*, occasionally. Specially Virchow's gland at outer border of left sternomastoid infected by spread along thoracic duct : *great diagnostic importance*. (3) Axillary, left. Occasionally inguinal, etc.**LIVER.**—In about 30 per cent. Often very large.**OMENTUM, PERITONEUM, INTESTINE.**—In 20 per cent. Less common : Pancreas, lungs, and pleura.**SUBCUTANEOUS NODULES.**—At or near navel ; spread is along urachus. Peritoneum not necessarily affected.

Occasionally : Bones, brain, spleen, other parts.

Secondary Neoplasms in Stomach.—Very rare. Breast commonest primary site.**Carcinoma Secondary to Gastric Ulcer.**—History suggesting previous ulcer present in 5 to 10 per cent ; usually long duration, twenty to thirty years ; gastric contents as in gastric ulcer. Pathological examination and results of autopsy also suggest previous simple ulcers with similar frequency. This is most probable percentage ; but Mayo and some others give up to 80 per cent, the latter figure undoubtedly greatly excessive.*Frequency of gastric ulcer becoming cancer* is about 3 per cent. A person with gastric ulcer has little, if any, greater liability to cancer than a normal individual. At the margins of a chronic ulcer, areas of regeneration may occur, due to chronic inflammation : liable to be mistaken histologically for neoplasm.

Carcinoma secondary to gastric ulcer has certain differences from the primary carcinoma described in paragraphs below :—

1. **MODE OF ONSET.**—Two stages, usually recognized without difficulty : (a) Prolonged history of dyspepsia, very rarely under 20 years : distinct symptoms of ulcer, e.g., hæmatemesis, not common. (b) Short recent period, not exceeding few months, characterized by definite exacerbation of symptoms, developing condition as in primary forms.
2. **GASTRIC ANALYSIS.**—*As in gastric ulcer*. Free HCl usually present.

DIAGNOSIS of carcinoma and distinction from gastric ulcer rest principally on recognition of second stage.**Symptoms of Primary Carcinoma.**—**MODE OF ONSET.**—Insidious but rapid ; history of gastric symptoms is short, not exceeding few months, and previous dyspepsia strikingly rare. Initial complaint usually pain, dyspepsia, vomiting, or loss of weight. Advance of symptoms rapid and no period of remission.**CARDINAL SYMPTOMS.**—**ANOREXIA.**—Especially for meat. Flatulence common.**PAIN.**—Early symptom ; usually epigastric, may be referred to shoulder or back, worse after food, increased by pressure ;

partly, but not entirely, relieved by vomiting. *Character*: dragging, less intermittent than in gastric ulcer, and paroxysms rare. Becomes continuous.

NAUSEA AND VOMITING.—At onset, occasional vomiting, often rapidly becoming more frequent. With cancer of cardia, shortly after food; with pyloric cancer, after an interval; with cancer of body, may be absent. Relief after vomiting in early stages: later very slight. Nausea becomes continuous.

LOSS OF WEIGHT.—Progressive, becoming extreme: factors are the growth, low diet, vomiting, and imperfect gastric juice. Temporary improvement may follow (1) dieting, (2) lavage (if stomach dilated), and may be deceptive. Loss of strength is proportional to loss of weight.

CACHEXIA AND ANÆMIA.—Often almost diagnostic: develop rapidly.

HÆMORRHAGE.—(1) Blood usually present in vomit: may be 'coffee-grounds'. (2) *Occult blood in feces*; rarely absent, even under treatment. (3) Profuse hæmatemesis rare.

LESS CONSTANT AND IMPORTANT.—

CONSTIPATION.—Usual. Rarely diarrhoea.

FEVER.—Variable, occasional rises not uncommon.

Œdema of ankles, and general results of anæmia. Urine: occasionally albuminuria, rarely acetonuria (starvation).

Symptoms due to complications may cause attention first, e.g., liver, glands, nodules.

LATENT CARCINOMA.—Occasionally found accidentally or post mortem, without symptoms: very rare.

Physical Signs.—All examination may be negative.

INSPECTION.—Look for: epigastric prominence; aortic pulsation marked; peristalsis (obstruction); subcutaneous nodules near navel; tumour may be visible, moving with respiration.

PALPATION.—

TUMOUR frequently palpable; hard, often nodular; early pyloric tumours often very mobile, later fixed by adhesions. At cardia, covered by ribs. Tumours on posterior wall may become impalpable when stomach is distended.

TENDERNESS variable. May be marked and diffuse in later stages with severe pain and vomiting, and thus prevent palpation.

LYMPHATIC GLANDS.—Especially in neck, and left axilla.

Radiographs.—

1. 'Filling defects': irregularities due to the growth.

2. Interference with progress of peristaltic waves.

Note.—An indurated ulcer or perigastric adhesions may produce similar results and be indistinguishable.

Gastric Analysis.—Changes in gastric secretion are present at onset of earliest symptoms, and progressive diminution to final absence of free HCl is not observed. Characteristics: (1) Free HCl absent (Günzburg's test) after histamine injection. (2) Total acidity low; usually equivalent to 15 to 35 c.c. $\frac{1}{16}$ HCl per cent, i.e.,

Cancer of the Stomach—Gastric Analysis, continued.

0.05 to 0.13 gm. HCl. Free acid (Töpfer's test) may be present, due to organic acids. With obstruction, total acidity may be high from organic acids. (3) Contents often foul. (4) Blood present.

Notes.—(1) Increase of lactic and other organic acids; may be sarcinæ and Oppler-Boas bacilli, but these of little diagnostic importance. (2) For carcinoma secondary to gastric ulcer, see p. 440. (3) In pernicious anæmia and achylia gastrica, total acidity usually much lower.

Changes in the Blood.—Anæmia constant, but often less than facies suggest. Slight leucocytosis not uncommon.

MEGALOCYTIC ANÆMIA.—Due to absence of intrinsic gastric factor. May thus resemble pernicious anæmia, but leucocytosis nearly always present and with care distinction is possible (see **PERNICIOUS ANÆMIA** and **MEGALOCYTIC ANÆMIA**). In rare cases, metastasis in bone-marrow. Pernicious anæmia may coexist.

Special Sites and Types of Growths.—

1. **CARDIAC ORIFICE.**—*Dysphagia*. Epigastric pain and vomiting immediately on ingestion.
2. **PYLORUS.**—Often produces pyloric obstruction (q.v., p. 443).
3. **COLLOID CARCINOMA.**—Spreads by direct extension to omentum, etc., producing large masses.
4. **LEATHER-BOTTLE STOMACH.**—See **CIRRHOSIS OF THE STOMACH**, p. 422.
5. **'CARCINOMA SECONDARY TO GASTRIC ULCER'.**—See p. 440.

Complications.—

1. **HÆMATEMESIS.**—Rarely fatal (usually splenic artery).
2. **PYLORIC OBSTRUCTION.**
3. **SECONDARY GROWTHS.**—See p. 440.
4. **JAUNDICE.**—From neoplasm in liver, or pressure of glands in portal fissure.
5. **PERFORATION.**—Rare. Into peritoneum causes general peritonitis, or local abscess if adhesions: occasionally into colon: rarely into pleura, lungs, etc.
Occasionally: (6) Gangrene of growth; (7) Thrombosis of femoral or saphenous veins.

Course and Termination.—Symptoms usually well marked in two to four months from initial trouble. *Progress* with rapid wasting, and increase of pain and vomiting. *Duration* commonly nine to eighteen months; rarely exceeds two years. *Death* from asthenia, with consciousness to the end; rarely in coma.

Diagnosis.—*Characteristics* are: (1) Onset and rapid progress of dyspepsia and wasting *without previous gastric trouble*; (2) Absence of free HCl; (3) Presence of tumour. (See also **CARCINOMA SECONDARY TO GASTRIC ULCER**, p. 440.)

METHODS OF DIAGNOSIS.—Include: (1) Symptoms and examination; (2) Radiographs; (3) Analysis of gastric contents;

(4) Examination of blood; (5) Occult blood in *faeces*; (6) Gastroscopy; (7) Exploratory laparotomy in all cases of doubt.

Note.—(1) Absence of gastric symptoms practically excludes gastric cancer even when tumour present. (2) Since duration of symptoms of primary carcinoma does not exceed 2 years, and of carcinoma secondary to gastric ulcer is rarely under 20 years, symptoms of intermediate duration are very rarely due to carcinoma. (3) Absence of free HCl with duration of symptoms exceeding 2 years is against carcinoma.

TUMOUR NOT PALPABLE.—Difficulties are:—

CHRONIC ATROPHIC GASTRITIS.—Long gastric symptoms with absence of free HCl. Cachexia absent.

DILATED STOMACH.—Long gastric symptoms. Radiographs.

GASTRIC ULCER.—Pain related to food; eased by alkalis; periods of remission.

PERNICIOUS ANÆMIA.—Changes in the blood: almost total absence of gastric secretion. Van den Bergh test indirect positive.

PULMONARY TUBERCULOSIS.

Treatment.—

SURGICAL.—Operation contra-indicated only by secondary deposits, e.g., jaundice, or by very advanced state, not by palpable tumour.

OPERATIONS.—(1) Excision of growth, and gastrojejunostomy;

(2) Gastrojejunostomy alone, if tumour irremovable;

(3) Gastrostomy (cancer of cardia). Results are improving.

Careful medical treatment *before and after operation*.

MEDICAL.—Palliative only. As in dyspepsia, modified to circumstances.

DIET.—Small, frequent feeds; especially peptonized milk, custards, etc. Avoid meat.

PAIN.—May need morphia, conveniently as tablets gr. $\frac{1}{2}$ under the tongue, one or two in twenty-four hours.

HÆMATEMESIS.—Treatment rarely of any effect.

OTHER FORMS OF GASTRIC TUMOUR.

SARCOMA.—Very rare. Usually under 25 years old. Rapid growth, large size, but without attacking mucous membrane, and hence no vomiting or hæmatemesis.

INNOCENT TUMOURS.—Polypi, adenomata, and various tumours are recorded. Mainly of pathological interest only.

HYDATID CYSTS.—Not very rare in affected countries.

FOREIGN BODIES.—Hair tumour.

K. PYLORIC OBSTRUCTION AND STENOSIS.

Etiology.—

1. **CICATRIX OF ULCER.**—Duodenal: in about 90 per cent of cases. Males in high percentage. Gastric: uncommon (occurs with rare hour-glass stomach).

Pyloric Obstruction and Stenosis—Etiology, continued.

2. NEOPLASMS.

3. PYLOROSPASM OR ŒDEMA OF MUCOUS MEMBRANE.—
Due to juxta-pyloric ulcers; may be intermittent, may respond to treatment. Moderate pylorospasm may occur with cholecystitis and appendicitis.

Rarely from adhesions to gall-bladder. Never from gastroparesis and atonic dilatation, see p. 424. Occurs rarely with chronic peritonitis and linitis plastica. For congenital pyloric stenosis, see p. 445.

Results of Pyloric Obstruction.—In initial stages or with intermittent cause: extreme peristalsis, stomach not necessarily large, may be hypertrophy. Dilatation follows *rapidly* from loss of tone, if obstruction chronic.

1. Dilated Stomach from Chronic Pyloric Obstruction.—

SYMPTOMS.—May be history suggesting ulcer or neoplasm.

a. **EPIGASTRIC DISCOMFORT.**—Sensation of fullness. Flatulence (offensive if cancer). Anorexia. Pain is usually not marked.

b. **VOMITING.**—Characteristic symptom. Note: (i) Quantity large. (ii) Intervals irregular: often several days: no direct relation to food. Gives temporary relief.

Characters of Vomit.—Sour smell. Separates into three layers, froth, fluid, and food: in lowest level articles ingested long previously.

c. **WASTING.**—Dry skin. Constipation.

TETANY.—May develop from loss of chloride in excessive vomiting or lavage. High mortality.

BLOOD-UREA.—May rise to 100 to 150 mgm. From alkalosis or dehydration: is pre-renal.

PHYSICAL SIGNS.—

a. **STOMACH SPLASH.**

b. **PERISTALSIS.**—Usually not visible, or occasionally on stimulation.

c. **TUMOUR.**—May be palpable.

GASTRIC ANALYSIS.—

a. **ULCER.**—Resting juice: large amount, may be food; free HCl variable. Fractional test-meal: free HCl rises high with sustained plateau (may be delay in appearance); total acidity definitely higher than HCl; starch persists (slow emptying).

b. **NEOPLASM.**—Contents offensive; no free HCl; total acidity initially high; blood common.

RADIOGRAPHS.—

a. Opacity in bowl-shaped area as in atonic dilatation, but usually evidence of peristalsis.

b. Emptying time prolonged: many hours.

c. Pylorus not visualized. May be filling defect.

TREATMENT.—Operation. Preliminary treatment to cleanse stomach.

2. Initial Stage or with Intermittent Cause.—Duration short if obstruction permanent.

SYMPTOMS.—May resemble ulcer. *Pain* may be severe and spasmodic and related to food.

VOMITING.—Usually frequent: causes partial relief: quantities small.

APPETITE.—May be normal, but is rapidly satiated.

PHYSICAL SIGNS.—

INSPECTION.—*Peristalsis visible*: large waves from under left costal margin passing slowly to right at and above umbilicus: one to four waves in cycle followed by quiescent interval of about $1\frac{1}{2}$ minutes. Epigastrium distended.

PALPATION.—Splashing as in dilated stomach. Tumour may be palpable at pylorus.

RADIOGRAPHS.—

a. Stomach practically normal in size and shape.

b. Peristalsis: powerful waves In series with quiet intervals.

c. Meal retained many hours (over 8), may be days.

TREATMENT.—Prolonged treatment as for ulcer. Alkalosis develops readily. In after-treatment, evening meals small.

XI. CONGENITAL HYPERTROPHY OF THE PYLORUS.

(*Congenital Hypertrophic Stenosis of the Pylorus.*)

Etiology.—

AGE.—Onset of symptoms commonest in 2nd to 4th week of life.

Note.—Congenital stenosis producing symptoms in adults has been described, but is doubtful, and certainly extremely rare.

SEX.—More frequent in males (5 to 1). About half occur in first children.

RACE.—Rare in Latin races.

Pathology.—Thickening of pylorus, due mainly to hyperplasia of muscular coat, especially circular layer. Stomach wall also thickened, especially near pylorus; may be some dilatation.

THEORIES.—(1) Congenital hypertrophy. Improbable. (2) Pylorospasm: from failure of the normal relaxation of the pylorus, due to inco-ordination of infancy. Probable: cases may recover while tumour is still palpable.

Symptoms.—

VOMITING.—*Sudden, projectile*, and often *copious*: onset commonest in 2nd to 4th week: less often from birth: frequency variable.

WASTING.—Becomes extreme.

CONSTIPATION.—Diarrhoea is serious complication.

Pain and colic common.

Depending on above symptoms: oedema, convulsions, subnormal temperature, and symptoms of tetany.

Congenital Hypertrophy of the Pylorus, continued.

Physical Signs.—Characteristic are :—

VISIBLE PERISTALSIS.—Especially after food ; large waves passing left to right, often several waves visible. Repeated examinations may be necessary.

PALPABLE TUMOUR.—Firm, hard, movable tumour in position of pylorus ; also best felt after food.

Dilatation is variable, usually absent.

Gastric Analysis.—Hyperchlorhydria. No bile.

Radiographs.—Delay in emptying.

Diagnosis.—Characteristics : (1) Onset under six weeks ; (2) Chronic projectile vomiting ; (3) Visible peristalsis ; (4) Wasting ; (5) Tumour ; (6) Radiographs.

CONGENITAL DUODENAL STENOSIS.—Vomiting from birth, bile present.

Course.—No sequelæ in survivors. If under medical treatment, tumour disappears.

Treatment.—Operation should be advised when diagnosed.

SURGICAL.—Rammstedt's operation : division of the muscular coat. Good results. Feeding after operations needs great care.

MEDICAL.—Only in very mild cases. (1) Lavage, morning and evening ; (2) Feeding, $\frac{3}{4}$ j per hour.

ALKALIS to neutralize hyperacidity, e.g., sodium citrate (gr. ij) added to each feed.

If loss of weight continues, operation.

In late stages mortality is high with either medical or surgical treatment.

XII. HÆMATEMESIS.

(*Hæmorrhage from the Stomach.*)

Etiology.—

LOCAL DISEASE OF STOMACH.—

1. PEPTIC ULCERS.—See p. 434.

2. NEOPLASMS.

3. CHRONIC GASTRITIS.—Due to erosions, i.e., gastrostaxis. See p. 408.

4. ACUTE GASTRITIS, e.g., alcoholic. Streaks of blood only.

PASSIVE CONGESTION OF THE PORTAL SYSTEM.—

(1) *Cirrhosis of liver*—common (usually from veins at cardia) ; (2) Congestive heart failure (rare) ; (3) Tumours pressing upon, or thrombosis of, portal vein.

BLOOD SWALLOWED.—Origin : from nose, pharynx, lungs, or œsophagus.

BLOOD DISEASES.—Splenic anæmia ; occasionally acute leucæmia, hæmorrhagic diathesis, etc. Very rare in hæmophilia.

Occasional causes :—

TRAUMA.

CORROSIVE POISONS AND GASTRO-INTESTINAL IRRITANTS.—Strong acids and alkalis, arsenic, etc.

TONIC.—(1) Specific fevers: yellow fever, small-pox, malignant scarlet fever. (2) Various toxæmias, e.g., acute yellow atrophy, septicæmia.

RUPTURE OF ANEURYSM.—Aorta or branches.

Profuse Hæmorrhage.—Commonly due to: (1) Peptic ulcer. (2) Cirrhosis of liver.

Rare causes of profuse and fatal hæmorrhage: splenic anæmia, ruptured aneurysm.

Rarely profuse or fatal in other forms.

Morbid Anatomy.—In fatal cases, always general anæmia.

STOMACH.—In gastric ulcer, cancer, corrosive poisoning; disease visible. In toxæmic cases: hæmorrhages into mucosa.

In obstruction to portal system: mucosa pale, no lesion, œsophageal veins often not obvious. In chronic gastritis: no bleeding point may be found, or careful examination may reveal minute erosions.

Symptoms.—Apart from vomiting of blood, are mainly due to the resultant anæmia.

CHARACTER OF VOMITED BLOOD.—Usually dark, airless, and may be acid; fluid or clotted. Altered by gastric juice, depending on time in stomach, e.g., 'coffee-grounds' vomit.

AMOUNT.—May be several pints.

ON OCCURRENCE OF BLEEDING INTO STOMACH.—Fainting common, cold sweat, nausea, collapse. For subsequent symptoms see ACUTE HÆMORRHAGIC ANÆMIA.

Diagnosis.—Questions arising are :—

1. IS COLOUR DUE TO BLOOD?—Difficulties occasionally occur from iron, bismuth, fruit juice. Microscopic and chemical tests.
2. SOURCE OF THE BLOOD.—Patient is usually reliable as to whether the blood is vomited or coughed up.

HÆMATEMESIS	HÆMOPTYSIS
History and signs of gastric or abdominal disease.	Pulmonary or cardiac disease.
Blood vomited.	Blood coughed up.
Airless, dark, acid, usually clotted.	Frothy, red, fluid, alkaline.
Sputum not stained after twenty-four hours.	Sputum stained for several days.
Food may be present.	
Melæna may occur.	

SWALLOWED BLOOD.—Origin often recognizable in nose, throat, or mouth.

Treatment.—See p. 435.

XIII. DUODENAL OBSTRUCTION.*(Chronic Duodenal Ileus. Acute Dilatation of the Stomach.)***Types.**—Two clinical types:—

1. **CHRONIC DUODENAL ILEUS.**—*Synonym*: Chronic (intermittent) duodenal obstruction. Is more correctly 'obstruction' than 'ileus'.
2. **ACUTE DILATATION OF STOMACH.**—*Synonyms*: Acute duodenal obstruction. Acute gastro-duodenal ileus.

Pathogenesis.—Following is provisional description of principle factors.**OBSTRUCTION TO THIRD PART OF DUODENUM.**—Usual primary factor. Congenital anatomical abnormality: slight increase of constriction by mesenteric vessels and root of mesentery; occasionally sharp duodeno-jejunal flexure.**IN INFANCY AND CHILDHOOD.**—Causes intermittent obstruction (in newborn infants may be continuous) of duodenum with resulting dilatation, and with secondary obstruction to emptying of stomach shown in radiographs by delayed gastric emptying and hyperperistalsis. For clinical symptoms, *see below*. *Progress*: Stomach and duodenum may compensate, by hypertrophy, for obstruction; clinical symptoms and attacks may then diminish during later childhood.**IN ADULTS.**—Frequent, but not invariable, history of attacks similar to above in childhood (diminishing at puberty) suggests adult condition is often continuation or sequela of congenital form. Manifestations may be:—

1. 'Chronic duodenal ileus'. Dilated duodenum is predominant feature. Persistence from childhood.
2. 'Acute dilation of stomach'.

'ACUTE DILATATION OF STOMACH'.—*Note*: (1) History common of attacks in childhood. (2) Has developed in adult in case known to be duodenal ileus in childhood. (3) Gastropptosis usually known to be present previously. (4) At autopsy, head of pancreas may be found pulled forward. (5) Dilatation commences at or near mesenteric vessels.**MODE OF DEVELOPMENT.**—(1) Sudden dilatation of stomach (previously atonic) from severe loss of tone due to shock, etc., or large meal; (2) Pull of stomach drags on duodenum. (3) If first part is incompletely fixed, duodenum is pulled round pancreas, like cord round pulley, drawing pancreas forward; drag transmitted to site of constriction in third part produces definite obstruction; may be aided by concomitant prolapse of small intestine. (4) Condition thus becomes acute intestinal obstruction, resulting in further extreme dilatation above obstruction. Sequence is thus: (a) Congenital form in childhood; (b) Compensation in puberty; (c) Acute dilatation of stomach under a stimulus; (d) Duodenal obstruction in third part; (e) Final extreme dilatation above obstruction.

VARIOUS FEATURES.—

1. Visceroptosis not uncommonly present. Sag of loop of small intestine may pull on root of mesentery, which is often long in these cases; or a lax cæcum and ascending colon. Final 'acute dilatation of stomach' identical, whether starting from stomach or duodenum, as in this group.
2. Sharp duodeno-jejunal angle with some fibrosis may be site of obstruction.
3. Pressure of stomach on duodenum is improbable exciting factor.

OBSTRUCTION BY DUODENAL ADHESIONS.—May cause dilatation of first and second parts of duodenum, but not lower: not uncommon, probable cause of 50 per cent of cases of chronic duodenal ileus in adults.

Neoplasm of head of pancreas: occasional cause.

DUODENAL ILEUS IN INFANCY.

Symptoms.—(1) Refusal of food; (2) Vomiting (bile unusual)—may be forcible, due to gastric distension.

Diagnosis.—From pyloric stenosis: duodenum visible in radiographs.

Treatment.—Gastric lavage, twice daily. Prognosis good. Operation contra-indicated.

DUODENAL ILEUS IN CHILDHOOD.

Symptoms.—Underweight, lack of appetite; pain often not marked. *Periodic attacks of vomiting*: pyrexia, tongue furred, general malaise. Pain often not severe. Constipation or diarrhoea. Fat in fæces may be excessive (bile deficiency), and colon dilated.

Physical Signs.—Epigastrium prominent. Stomach dilated; splashing, may be peristalsis.

Radiographs.—Stomach dilated, with stasis and hyperperistalsis. Duodenum enlarged, various degrees.

Diagnosis.—From coeliac disease.

Treatment.—Small dry meals: little fat. Massage. Operation difficult.

Prognosis.—Attacks usually diminish during puberty.

CHRONIC DUODENAL ILEUS IN ADULTS.

(*Chronic Intermittent Duodenal Obstruction.*)

Etiology.—Females commonest. Any age, usually 25 to 35 years.

Pathogenesis.—Obstruction may be: (a) In third part—congenital; (b) In first and second parts—adhesions; (c) In both. Symptoms indistinguishable. Symptoms due to: (1) Gastric distension—constant; (2) Duodenal obstruction—intermittent.

Chronic Duodenal Ileus in Adults, *continued*.

Symptoms.—Often of many years' duration. Continuous or often remittent, following fatigue, nervous strain, or large meals. May be history since childhood of digestive disturbances, vomiting, and 'bilious attacks'.

EPIGASTRIC FULLNESS AND DISCOMFORT after meals.

Anorexia may be persistent, and *loss of weight* severe.

PAIN.—Onset $1\frac{1}{2}$ to 2 hours after meals. Site various: in left flank (suggests third part) or right epigastrium (first and second parts). Not eased by food or alkalis: may be eased by lying on face.

VOMITING.—May be in recurrent attacks with pain or with migraine. Nausea common.

CONSTIPATION.

TOXIC SYMPTOMS.—Headache, lassitude. May be typical migraine: but no family history.

Physical Signs.—Often none. In third-part obstruction: viscerop-tosis.

Radiographs.—In third-part obstruction: duodenum dilated, peristalsis and antiperistalsis. In first-part obstruction: duodenum may appear small and deformed, or cap dilated. Stomach empties slowly.

Complications.—Peptic ulcers and gall-stones not uncommon.

Treatment.—(a) *Medical*: bland, frequent, low-residue meals; knee-elbow position daily; abdominal massage and exercises; corset belt. (b) *Surgical*: generally indicated, duodeno-jejunostomy; good results.

ACUTE DILATATION OF THE STOMACH.

(*Acute Duodenal Obstruction.*)

Etiology.—

1. Post-operative, or during general anaesthesia. Accounts for 75 per cent of cases. Immediate or at intervals up to several days. Specially with, but not confined to, operations on kidney and gall-bladder: also after stomach operations, even with gastro-enterostomy.

Rarely:—

2. Large meal with atonic stomach.
3. Injuries to abdomen, head, or spine.
4. In convalescence or course of severe wasting diseases.

Symptoms.—(1) Sudden onset; (2) Vomiting enormous quantities, non-faecal, may be black; (3) Abdomen distended, peristalsis rare; (4) Collapse rapid. Mortality 75 per cent. Diagnosis simple. May be history, as in chronic duodenal ileus, of digestive disturbances since childhood. Subacute forms occur rarely, with extreme emaciation.

Treatment.—Pass stomach-tube and empty repeatedly; leave small tube in position. Turn on to abdomen. Collapse is partly due to loss of chloride, producing alkalosis; inject calcium chloride as in tetany.

OPERATION.—Contra-indicated; results very bad; jejunostomy usually attempted.

DIVERTICULA OF DUODENUM.

Rare. Usually in later life.

Classified as: (1) *Congenital*: no cause found. (2) *Acquired*, e.g., result of ulcer; in first part; very rare (not referred to here).

Pathology.—(1) In second, third, or rarely fourth part: never first. (2) Often multiple. (3) Arise from concave border. (4) Narrow neck. (5) Formed by mucous membrane only; no muscular coat. (6) Retroperitoneal; in contact with pancreas.

Symptoms.—No pathognomonic features. Symptoms often vague. May simulate ulcer: (1) long duration of attacks of severe pain; (2) vomiting frequent. Colitis common. Inflammation of sac rare.

Radiographs.—Diverticula may be overlooked if meal does not enter.

Treatment.—Unsatisfactory. Removal not always followed by relief.

XIV. CYCLICAL VOMITING.

(*Periodic Vomiting.*)

Recurrent attacks of vomiting occurring or commencing in childhood, usually accompanied by headache and evidences of acidosis.

General Description.—

AGE AT ONSET.—Commonly 3 to 10 years.

ATTACKS RECURRENT.—Some periodicity, often 3 or 4 weeks, but intervals rarely regular, and frequently longer.

ONSET.—Usually sudden. Subject wakes with symptoms. May be irritability and heavy breath on previous day.

DURATION.—1 to 5 or 6 days.

VOMITING.—Forcible and repeated. Usually no nausea and no definite gastric pain. At first food, later bile.

HEADACHE.—Often severe: may precede vomiting: usually frontal and bilateral. May be absent.

ACETONE.—Acetone and aceto-acetic acid in urine: may be recognizable in breath.

DURING ATTACKS.—Constipation obstinate. Tongue coated. Breath heavy. May be dyspnoea. Temperature variable. Unable to take any food and sometimes fluid. Becomes pale, drawn, prostrate, and drowsy.

BETWEEN ATTACKS.—Health often good and recovery rapid, but, if attacks are frequent, patient becomes thin and pale and digestion is impaired.

Cyclical Vomiting, continued.

Progress and Prognosis.—Attacks usually diminish or cease during puberty. Not infrequently extend into adult life in less severe form. Later migraine or more often migrainoid attacks occur. Rarely fatal.

Pathogenesis.—Doubtful. Heredity common. More frequent in, but not confined to, highly-strung constipated sedentary children. Probably several types of errors of metabolism, some of fats, some of hypoglycæmia, acidosis resulting. No obvious connection with protein hypersensitiveness. Mild degrees common.

Treatment.—

BETWEEN ATTACKS.—Treat as coeliac disease and hypoglycæmia.

1. *Diminish fats*, especially milk (Still): no cream; butter sparingly. Intervals between food short.
2. Plain sugar: may be given as barley sugar or two or three lumps of sugar after meals in water.
3. Alkalis: sodium bicarbonate gr. x to xxx t.d.s.
4. Regulate bowels.

Must be continued for several years. Not absolute preventive of attacks.

DURING ATTACK.—Best left alone at rest in dark room. No treatment will end attack. Enema. Fomentation or mustard leaf to epigastrium. Ice to suck, or hot water. Food not to be pushed, but attempt small frequent drinks of fluids. Salines per rectum if collapsed.

CHAPTER LXXXIII.

DISEASES OF THE INTESTINES.

I. CHARACTER OF STOOLS: NORMAL AND ABNORMAL.

Normal Fæces.—

WEIGHT.—About 5 to 6 ounces daily. (140 to 180 grammes).

COLOUR.—Brown, due to stercobilin (identical with urobilin).

Unaltered bile pigment not present, being absorbed from intestine: stercobilin is altered bile pigment excreted from gut wall.

ODOUR.—Fæcal, but only slightly offensive.

CONSISTENCE.—Firm and formed.

REACTION.—Faintly alkaline, or faintly acid, to litmus.

WATER.—Forms about 75 per cent.

PROTEIN.—None on ordinary diet.

FAT.—Forms 20 to 25 per cent of *dried* fæces. About equal amounts of neutral fats and fatty acids (sodium and potassium salts, i.e., soaps).

UNDIGESTED FOOD.—Present microscopically only. Vegetable débris and cellulose.

MICROSCOPICAL.—Undigested food, epithelial cells, bacilli. Crystals of calcium phosphate and oxalate, and occasionally cholesterin and Charcot-Leyden crystals.

These characters apply to an adult on a mixed diet. On a diet rich in vegetable and starchy food, the quantity is larger and the consistence softer, water forming 80 to 85 per cent. On a diet rich in animal food, the quantity is smaller and the consistence firmer, water forming 60 to 70 per cent.

A child of one year passes about 3 ounces daily. All daily amounts are subject to considerable individual variations.

Abnormalities of the Stools.—In constipation, scybala or hard masses. Ribbon-shaped stools occasionally in disease of sigmoid, and also from contraction of anal sphincter apart from disease of intestine.

Practically, abnormalities of stools are connected with diarrhoea, with few exceptions.

CONSISTENCE.—A loose motion in an adult is abnormal.

COLOUR.—

GREEN OR YELLOW-GREEN.—Small and large gut both affected (from rapid peristalsis): especially in children, and after mercury.

YELLOW.—Senna rhubarb, or santonin may cause such colour.

DARK OR BLACK.—(1) Bismuth, iron (sulphides); (2) Blood, origin from above cæcum, but cannot be further localized.

CLAY-COLOURED.—(1) From absence of bile pigment in biliary obstruction; is accompanied by jaundice and biliuria; colour partly due to increase of fat (fatty acids). (2) From absence of pancreatic secretion causing failure to split neutral fats.

ODOUR.—Offensive odour from putrefaction (bacterial decomposition mainly by anaerobes) of proteins, and production of amino bodies, indole, skatole, etc.

REACTION.—*Acid* if much decomposition of carbohydrates (mainly children).

MUCUS.—Large quantities have origin from colon or rectum, usually as slime or strips. In: (1) Colitis—acute, ulcerative, dysenteric, etc.; (2) Muco-membranous colitis; (3) Cancer of colon or rectum. Rarely, occurs in disease of Fallopiian tubes.

BLOOD.—(1) Red streaks: from anus and rectum. (2) Mixed roughly, and colouring mucus: from colon. (3) Black stool, i.e., melæna: origin between stomach and cæcum.

PUS.—(1) Ulcerative diseases of colon; (2) Diseases of rectum; (3) Carcinoma of large intestine. Large amounts: usually from perforation of an extraneous abscess, e.g., appendix, broad ligament.

MEMBRANES OR 'CASTS'.—Muroid: In (1) Muco-membranous colitis; (2) Cancer of colon, tubo-ovarian disease—rare.

Diseases of the Intestines—Abnormalities of the Stools, continued.

FAT.—Excessive if bile or pancreatic secretion or absorption deficient. Pancreatic secretion (lipase) splits neutral fat into glycerin and fatty acid: process aided by, and subsequent *absorption of fatty acids* dependent on, bile. If: (1) Bile deficient and pancreatic secretion normal: total fat excessive, mainly *fatty acid*. (2) Bile normal and pancreatic secretion deficient: total fat excessive, mainly *neutral fat*. (See p. 539.)

UNDIGESTED FOOD.—Abnormal when macroscopic. Curds, excessive milk diet, and casein undigested.

ABNORMAL SUBSTANCES (macroscopic—stool washed through sieve).—Vegetable and food débris. Animal parasites. Gallstones. Mucous casts. Intestinal sand. Fragments of tissue: rarely in very rapid sloughing.

ABNORMAL SUBSTANCES (microscopic).—Undigested muscle fibre (visible striations). Excessive undigested fat: refractile particles. Pus cells. Red blood-cells. Ova. Protozoa and cysts.

Special Tests, etc.—

Occult blood test and spectroscopic examination reveal small quantities of blood, and distinguish from iron or bismuth.

Excessive bacterial decomposition in small intestine is indicated by excess of ethereal sulphates and indican in urine.

Protein may be present.

Character of Stools in Special Conditions.—

TYPHOID FEVER.—‘Pea-soup’ stool: loose, uniform, light brown.

CHOLERA.—‘Rice-water’ stool: very watery, practically no smell or faecal matter.

DYSENTERY.—Mucus and blood (see p. 90).

OBSTRUCTIVE JAUNDICE.—Clay-coloured stool.

HÆMOLYTIC JAUNDICE.—Stool of normal colour.

MUCO-MEMBRANOUS COLITIS.—Mucus, and ‘membranes’ or ‘casts’. Occasionally intestinal sand.

PANCREATIC INSUFFICIENCY.—Light colour, frothy, bulky, greasy stool. Also in coeliac disease (see p. 491).

Local Inflammations and Character of Stools.—

CATARRH OF SMALL INTESTINE.—Colour greenish yellow, flocculent, mucus slight, undigested food. Diarrhoea not necessarily present: water absorption in colon may solidify stool.

CATARRH OF LARGE INTESTINE.—Gray or brown, thin, uniform: mucus excessive.

DUODENITIS.—Nothing distinctive.

JEJUNITIS, ILEITIS.—As in small intestine.

II. TYMPANITES.

Gaseous distension of the intestines occurs in: (1) Dyspepsia, gastritis, enteritis: common, transient. (2) Acute abdominal disease: obstruction, peritonitis, and after operations. (3) Acute infective

fevers : enteric, pneumonia, etc. The retention of the gases of putrefaction of proteins may be due to : (i) Paresis of intestinal muscle ; (ii) Obstruction ; (iii) Diminished absorption ; (iv) Increased formation.

Symptoms and Signs.—Abdominal distension, often painful. Tympanitic resonance. Diminished respiratory movements. Liver and diaphragm pushed up. May be passage of flatus.

Important sequela : Heart displaced upwards, beats faster : even rapidly fatal cardiac failure, especially if diseased. Also respiratory embarrassment.

Treatment.—

1. IN ABSENCE OF ACUTE ABDOMINAL CONDITIONS.—

i. LOCAL TO ABDOMEN.—Hot fomentations. Turpentine stupes. Gentle massage.

ii. BY MOUTH (of little use in serious cases).—Essential oils, e.g., ol. cajuput ℥j to ℥ij on sugar ; turpentine ℥v to ℥x, hourly ; sal volatile ℥x, half-hourly, 6 doses.

iii. ENEMA.—Turpentine ℥ss to ℥ij. Prepare a soap and water enema, and divide into two parts : to one half add the oil and inject, and follow shortly with remaining half.

iv. PITUITARY EXTRACT, e.g., PITUITRIN.—Hypodermic injection of 1 c.c. Most powerful and effective treatment. Two or three injections at intervals of 4 hours.

2. ACUTE ABDOMINAL CONDITIONS.—Operation.

The passage of a long rectal tube is useless.

III. DIARRHŒA. ENTERITIS. COLITIS.

(See also DIARRHŒA IN CHILDREN, p. 467.)

Diarrhœa may be : (a) Primary or secondary ; (b) Acute or chronic ; (c) Due to disturbances of entire alimentary canal or some portion only.

CAUSES OF DIARRHŒA.

(1) Primary ; (2) Secondary ; (3) Special types.

Primary Diarrhœa.—

DIETETIC.—Excessive, improper, or bacterially contaminated food.

Commonest cause. Idiosyncrasies common, especially in children.

CONSTIPATION.—Irritation of scybala or aperients. Common.

APERIENTS.—Common.

CHANGES OF WEATHER OR OF CLIMATE.—Little known of mode of action, probably bacterial, common in children.

(a) Chill, possibly catarrhal enteritis comparable to bronchitis ;

(b) Heat, especially sultry.

CHEMICAL IRRITANTS.—E.g., mercury, arsenic.

ALTERATION OF INTESTINAL SECRETIONS AND ABSORPTION.

NERVOUS DIARRHŒA.—In certain subjects.

Causes of Diarrhoea, *continued*.

Secondary Diarrhoea.—

INFECTIVE CONDITIONS.—(a) *Specific intestinal infections*—enteric, and numerous tropical diseases, e.g., dysentery, cholera.
(b) *General infections*—e.g., septicæmia.

DISEASES OF INTESTINES OR NEIGHBOURING PARTS.—Cancer, tuberculosis, chronic peritonitis: often alternating with constipation.

CHRONIC CIRCULATORY DISTURBANCES.—Portal congestion, cirrhosis of liver, chronic heart and lung disease: often obstinate diarrhoea.

RESIDUAL.—Sequel to attack of primary diarrhoea.

'IRRITABLE COLON'.—Recurrent transient frequency of the motions: sequel to former colitis.

TOXIC OR TOXÆMIC.—Uræmia. Hyperthyroidism.

LARDACEOUS DISEASE.—Very rare.

Special Types of Diarrhoea.—

ULCERATIVE COLITIS.—See p. 461.

MUCO-MEMBRANOUS COLITIS.—See p. 465. Diarrhoea is not necessarily present.

CLINICAL GROUPS OF DIARRHOEA.

Acute Diarrhoea.—Symptoms vary with severity, site, and extent of intestine affected.

1. GASTRO-ENTEROCOLITIS.—Entire tract affected.
2. GASTRO-ENTERITIS.—Stomach and small intestine. Usually upper part of colon also.
3. COLITIS.

Chronic Diarrhoea.—Often definitely referable to local portions of tract.

1. GASTROGENOUS DIARRHOEA.—Due to defective gastric digestion.
2. ENTERITIS.—
 - a. CATARRHAL OR INFLAMMATORY.—Due to mild or residual infection—e.g., after gastro-enteritis.
 - b. DEFECTS OF METABOLISM OR ABSORPTION.—
 - i. Carbohydrate—viz., 'intestinal carbohydrate dyspepsia'.
 - ii. Protein—viz., 'putrefactive diarrhoea'.
 - iii. Fats—viz., coeliac disease, idiopathic steatorrhoea, sprue, pancreatic disease. Also factor in cyclical vomiting, migraine.
3. COLONIC DIARRHOEA.—(a) Chronic catarrhal; (b) Ulcerative; (c) Dysentery, bilharzia, malaria; (d) Neoplasms; (e) Tuberculosis.
4. NERVOUS DIARRHOEA.

DIAGNOSIS.

Investigate :—

1. Symptoms and etiological factors. General examination.
2. Stools : Colour, reaction, consistency. Presence of faecal matter, gas, mucus (stained or unstained), blood, pus. Ova, parasites. Undigested striated muscle fibres, starch, fat.
3. Stools : Bacteriological examination.
4. Rectal examination.
5. Radiography, sigmoidoscopy : as indicated.

GASTRO-ENTEROCOLITIS.

Entire tract affected. Produces varying severities of '*diarrhœa and vomiting*'. Severe grades : as in acute colitis, with vomiting, anorexia, and furred tongue : may be rapidly fatal : recovery always tedious, usually residual chronic enteritis or colitis. *Treatment*.—See ACUTE COLITIS.

GASTRO-ENTERITIS.

Stomach and small intestine mainly affected : upper colon irritated by ileal contents. Resembles milder gastro-enterocolitis ; but when typical, note : (1) Pain colicky, not specially related to motions. (2) Stools dark green and homogeneous ; mucus scanty, intimately mixed and bile-stained. Usually chronic enteritis follows. *Treatment*.—See ACUTE COLITIS.

GASTROGENOUS DIARRHŒA.

Small and large intestine irritated by undigested food from stomach ; enteritis and colitis develop. Occurs with hypochlorhydria and achlorhydria and gastro-enterostomy. *Treatment*.—See HYPOCHLORHYDRIA, p. 415.

CATARRHAL ENTERITIS.

Due to mild or residual infection, e.g., after gastro-enteritis ; may follow chill in hot weather ; common in Tropics (sometimes mild Flexner infection).

Symptoms.—Often intermittent : when present, frequently severe depression, exhaustion, lack of concentration.

1. Abdominal discomfort : colicky, not localized, not directly related to food or motions. Pain rarely acute.
2. Abdomen moderately distended, diffuse tenderness.
3. Diarrhœa : slight, may be absent ; often alternating constipation. Flatus variable : may be absent or marked.
4. Sensation of flatulence, but no eructation (unless aerophagy). Tongue clean. Appetite good (when discomfort absent).

Treatment.—Very resistant to treatment. Bed rarely necessary. Often improved by exercise. Avoid chills.

DIET of little effect, if tongue clean.

ABDOMEN.—Keep warm (binder).

APERIENT.—*Daily saline.*

Catarrhal Enteritis—Treatment, *continued*.

DRUGS.—Bismuthi salicylas gr. v–xv t.d.s. Kaolin and charcoal. Intestinal antiseptics uncertain—e.g., dimol, kerol.

ASTRINGENTS.—Following useful: (1) Chalk: Mistura cretæ \mathfrak{z} ss t.d.s.; pulv. cretæ aromaticus gr. xxx (or c. opio gr. xxi) t.d.s. (2) Bismuth oxycarbonate gr. xx to xxx. (3) Tinct. chloroformi et morphinæ co. ('Chlorodyne') \mathfrak{M} v to x. Dilute sulphuric acid.

Prescription (example):—

R	Acid. Sulphurici Aromat.	\mathfrak{M} x
	Tinct. Chloroformi et Morphin. Co.	\mathfrak{M} v
	Aq. Chloroformi	ad \mathfrak{z} ss

Other common astringents: Pulv. catechu co. gr. xx to xl; pil. plumbi c. opio gr. ij to iv; ext. hæmatoxyli liq. \mathfrak{z} j (not with acids).

ACTION OF CHALK.—Calcium forms insoluble fatty acids, thus removing severe irritant: also neutralizes acids, slows contraction of involuntary muscle fibres, and lessens peristalsis.

Note.—Drugs usually have little effect (except aperients). Opium and morphia only to be used temporarily if diarrhœa troublesome.

INTESTINAL CARBOHYDRATE DYSPEPSIA.

Inefficient digestion of starch and absorption of carbohydrates in small intestine. Bacterial fermentation follows in colon, producing gas and causing diarrhœa and discomfort. Difficulty is with starch granules, rather than pure carbohydrates.

Symptoms.—

1. Discomfort and fullness due to colonic distension: may be worse after meals.
2. Flatus severe at night: may cause insomnia.
3. Distension of splenic flexure by gas during day may simulate gastric flatulence, resulting in aerophagy.
4. Bowels. Variable. If diarrhœa: stools acid, sour, bubbles of gas, undigested vegetable matter; microscopically, starch granules, usually no excess of fat or striated muscle fibres.
5. Radiographs. Rapid passage through small intestine.

Treatment.—

INITIAL.—Few days in bed. No carbohydrate, except sugar. Diet: tea, coffee, sugar, butter, cream, jelly, eggs. Usually rapid improvement.

AFTER-TREATMENT.—No vegetables or fruit containing intracellular starch. Give vitamin C, e.g., orange juice. Charcoal. Diastase. Colonic lavage useless.

PUTREFACTIVE DIARRHŒA.

Inefficient digestion of proteins in small intestine. Bacterial action in colon produces toxic substances causing diarrhœa, discomfort and toxæmia. May be achlorhydria.

Symptoms.—

Discomfort and abdominal symptoms as in carbohydrate dyspepsia.

Flatus offensive.

Diarrhoea: stools dark, alkaline, offensive, fluid.

Toxæmia may be marked: sallow. Tongue furred. Dry skin.

Anorexia. Loss of weight.

Treatment.—Rest in bed. Two days' fast, fluid and glucose.

Commence milk, 2 to 3 pints; add carbohydrates gradually, milk puddings, toast, biscuits, butter.

DRUGS.—As for catarrhal enteritis.

Often do well. No meat subsequently. Recurrences not infrequent.

ACUTE CATARRHAL COLITIS.

Occurs in all degrees of severity. Milder forms describable as 'simple diarrhoea'; stools retain faecal character. Severe forms resemble acute stages of **ULCERATIVE COLITIS** (p. 461).

Symptoms.—In case of moderate severity.

Onset sudden: may wake with colic; or few days previous disturbance. Vomiting at onset and if diet heavy. May be pyrexia.

Pain, especially with motions (tenesmus).

Abdominal distension and tenderness moderate.

Diarrhoea. Motions very frequent: fluid, faecal colouring, mucus.

Improvement usually commences in few days. Subsequent tendency to recurrences or chronic colitis.

Treatment.—The following applies only to the treatment of moderate degrees; for severe, see **ULCERATIVE COLITIS**, p. 464.

GENERAL HYGIENE.—Bed, if pyrexia or weakness, until temperature normal, and stools formed: *keep warm*, including limbs.

DIET.—If severe: Milk and lime water, or whey or albumen water with fluid *ad lib.* (in small cold drinks). If milder: Semifluids (custards, etc.). Avoid solids and hot food.

DRUGS.—Indications are: (1) Remove irritant; (2) Reduce irritation and inflammation present.

1. *Initial dose* of castor oil (℥j): if much pain add tinct. opii ℥xx. Or repeated smaller doses (℥j). Castor oil specially indicated within 12 to 24 hours of onset when origin from food or dyspepsia, but contra-indicated by previous excessive purging.

2. To check diarrhoea and peristalsis: not advisable under 24 hours unless severe.

a. Chalk: *Mistura cretæ* ℥ss-℥ij every two to four hours (tinct. opii ℥v may be added), or pulv. cretæ aromaticus c. opio gr. xx every four hours.

b. Bismuth and opium:—

<p>R Bismuthi Oxycarb. gr. xx Tinct. Chloroformi et Morphinæ Co. ℥x</p>	}	<p>Aq. Chloroformi ad ℥j</p>
4 to 6 doses daily.		

Other drugs: Acid. sulphuric. dil. ℥x; pil. plumbi c. opio (gr. ij to iv).

Acute Catarrhal Colitis—Treatment, *continued*.

SPECIAL TREATMENT.—

1. PAIN.—Warmth to abdomen. Opium by mouth. With severe colic or cramps, inject morphia gr. $\frac{1}{4}$.
2. VOMITING.—Ice to suck. Iced peptonized milk.
3. FLATULENCE AND DISTENSION.—Carminative (see *Dyspepsia*, p. 420). Turpentine enema (see p. 455). Pituirrin.
4. STIMULANTS.—Iced champagne. Brandy.

PROGRESS.—As diarrhoea and pain diminish, increase diet by eggs, milk foods, broth, jelly. May commence with peptonized milk. Avoid gruel, arrowroot, hot foods.

CHRONIC CATARRHAL COLITIS.

Occurs in various grades of severity. Onset may be residual from acute colitis; or insidious, motions increasing for many months without much disturbance of health or use of aperients. Sudden exacerbation of severity of acute colitis may occur at any time. Severe attacks: as in *ULCERATIVE COLITIS*. May occur for years in milder grades.

Symptoms.—Moderate severity.

Discomfort in lower abdomen relieved by motion.

Abdomen flaccid; tenderness slight or absent.

Diarrhoea. Stools: two to six or more daily; fluid, fæcal colouring, mucus.

Tongue clean. Appetite fair. Loss of weight during severer periods.

Vomiting is sign of severe exacerbation.

Note.—Appendix may be involved in inflammation of colon: operate if acute or definite, but usually no improvement in colitis.

Treatment.—In exacerbation, as for *ACUTE COLITIS*. For constipation in intervals; liquid paraffin, or enemata.

DIET.—No raw vegetables; vegetables as *purées*; no skins of fruit.

CERTAIN SPECIAL TYPES.

Nervous Diarrhoea.—Sudden loose motion occurs as result of excitement in certain persons, not necessarily neurotic. No ill effects apart from inconvenience. *Treatment.*—Instruct to resist inclination. Bromides and belladonna. Treat general condition.

'Lienteric Diarrhoea'.—Bowels open regularly after meals. Exaggeration of normal gastrocolic reflex, which normally produces motion after breakfast. Commonest in children: often has nervous origin, but care necessary, since in colitis motions may occur specially after food. *Treatment.*—As for nervous diarrhoea.

Morning Diarrhoea.—Bowels moving on rising; subsequently may be normal. Common causes: (a) Heavy meal over-night, specially with alcoholism; (b) Carcinoma of colon. Also in moderate chronic colitis and enteritis.

Fireman's Cramp.—Occurs in stokers and others. Frequent watery stools, with marked collapse, and severe muscular cramps (considerable resemblance to cholera). Due to loss of chloride by sweating. Give NaCl gr. x to gallon. (See TETANY.)

IV. ULCERATION OF THE INTESTINE.

Occurrence.—Ulcers of the intestine occur in:—

MECKEL'S DIVERTICULUM. See p. 490.

SPECIFIC INFECTIONS.—Typhoid, dysentery, tuberculosis, syphilis. Bilharzia.

ULCERATIVE COLITIS.

DIVERTICULITIS.

FOLLICULAR ULCERATION.—In children, and in secondary and terminal diarrhoea. Small ulcers with sharp edges: never perforate. No specific symptoms.

NEOPLASMS.

Rare forms:—

FOREIGN BODIES, EXTRANEOUS ABSCESS.

SIMPLE PERFORATING ULCER.—Solitary ulcer may perforate jejunum, cæcum, or colon. Very rare.

Symptoms.—Intestinal ulceration is suggested by: (1) Diarrhoea; (2) Abdominal pain, either (a) colicky, or (b) colonic tenderness and tenesmus if colon affected; (3) Hæmorrhage from rectum; (4) Stool may also show (a) mucus, (b) pus, (c) fragments of tissue.

V. ULCERATIVE COLITIS.

Ulcerative colitis is an inflammatory colitis which has proceeded to the stage of ulceration.

In acute bacillary dysentery and in acute colitis death may occur in a few days; the mucous membrane of the intestine in both conditions is then swollen and hyperæmic. Had life continued somewhat longer it is known that ulceration would have been present in bacillary dysentery; similarly ulceration is found to develop in acute colitis. Ulcerative colitis is thus catarrhal colitis of a certain grade of severity. In view of its common use, the term is retained here; the milder grades of acute or chronic colitis are described separately (see DIARRHŒA): conditions described here are of severe degrees.

Pathogenesis.—Unknown. No specific organisms. Shiga and Flexner bacilli can produce condition similar to acute stages, but are not cause of clinical ulcerative colitis; relation to Sonne's bacillus still uncertain, but rarely present. Non-dysenteric organisms agglutinable by patient's blood occasionally isolated, but causal relationship unproved. Barga's diplo-streptococcus is not confirmed or accepted. May be non-bacterial factors in some cases, e.g., vitamins.

Morbid Anatomy.—Colon dilated, not hypertrophied. Ulceration usually confined to colon: often extensive, irregular: edges infiltrated, not undermining: remaining mucous membrane

Ulcerative Colitis—Morbid Anatomy, continued.

thickened and *polypoid* in more chronic cases. Descending and pelvic colon and rectum most, and often only, affected. In early and very acute cases mucous membrane red and inflamed: ulceration slight.

Rarely: Liver abscesses. Multiple pyæmic abscesses.

Mode of Onset and Clinical Types.—Onset may be *sudden* or *insidious*. Clinically, type may be *acute* or *chronic*.

ACUTE FORM.—Onset may be absolutely sudden, or rapidly progressive in a few days. Commonest in young adults. Symptoms of acute type may also develop in chronic stage as exacerbation.

CHRONIC FORM.—Onset may be: (1) As in acute type, chronic stage being sequel; (2) *Insidious*—stools gradually become soft, then more frequent, condition progressing for months or years before considered serious.

Symptomatology.—**ACUTE FORM.—**

ONSET.—Patient may wake with sudden abdominal pain and call to stool. In others commences as simple diarrhœa, with rapid exacerbation in few days.

STOOLS (after intestine emptied).—Fluid, with very little fæcal matter; mucus in varying amount; blood often present from onset, may be large amount, bright red, never melæna; pus-cells, may be macroscopic amount.

PAIN.—Often severe, but relieved by motion (in early stage).

VOMITING.—At onset, once or twice.

PROGRESS.—Symptoms advance rapidly. Condition varies with severity: divisible into 'severe' and 'moderately severe' state, as in, and identical with, bacillary dysentery: for description, see **BACILLARY DYSENTERY**, p. 87.

No rapid recovery. May drift after improvement into chronic condition. Depends greatly on correct treatment.

CHRONIC FORM.—

DIARRHŒA.—Persistent. Varies but little day by day: no intermissions with constipation or passage of solid fæces.

STOOLS.—Often soft chocolate-brown colour; mucus and blood in varying amounts and degree of mixture; no solid fæcal matter.

GASTRIC SYMPTOMS.—Usually absent—i.e., no nausea, vomiting, flatulence. But produced by unsuitable diet.

APPETITE.—Fair until late stages. **TONGUE** often clean.

ABDOMEN.—No characteristics. Colon may be tender; sigmoid palpable. Pain often absent.

PROGRESS.—With careful and prolonged treatment, majority do well: complete recovery rare: colon usually permanently irritable. With incorrect treatment, acute exacerbations may occur: or fatal ending with increasing exhaustion, and intercurrent disease.

INTERMITTENT FORMS.—

STOOLS.—Motion may be passed well-formed, and another on same day typical of colitis, with blood, pus, and mucus (often early morning). May be over long period or during recovery. Tends to be resistant to treatment.

Complications.—

APPENDICITIS.—Indefinite or definite: removal does not cure colitis.

POLYPOSIS.—May develop in chronic cases: hæmorrhage persistent. May become malignant. In rectum can be cauterized. Colectomy occasionally indicated.

STRICTURES.—After healing in chronic cases. Obstruction rare if motions soft.

PERFORATION.—Rare. Usually multiple. Mortality very high, as condition of colon renders successful operation very rare.

ARTHRITIS.—Occasionally.

POLYNEURITIS.—Rare.

Course and Prognosis.—

Acute cases may die in few days. Most cases become chronic.

Chronic cases: improve under treatment; relapses common; permanent complete cure rare.

Vomiting: serious symptom, indicating gastritis and interfering with diet.

Constipation: common after recovery.

Diagnosis.—*Stools* to be examined macroscopically, microscopically, and bacteriologically. In colitis, character varies little day to day: no intermissions with constipation or solid fæces, except with treatment.

NOTE.—History often unreliable. May prove to be neurosis and constipation.

ACUTE FORM.—From dysentery, irritant poisons. Treatment takes precedence of diagnosis.

CHRONIC FORM.—Period of observation in all cases: history often inaccurate. Diagnosis from:—

1. **MUCO-MEMBRANOUS COLITIS.**—Characteristics: neurosis, constipation, mucous casts. Easy with observation.

2. **DYSENTERY.**—Examination of stools and rectal swabs. Residence in dysenteric countries.

3. **NEOPLASM OF COLON.**—Diagnosis rarely difficult with few days' observation: (a) Pelvic colon: stools irregular and varying in type; not true diarrhoea; obstruction early. (b) Splenic colon: obstruction very early. (c) Hepatic colon: pain and discomfort; maximum in area involved. (d) Cæcum: tumour palpable; local discomfort.

Note.—With constriction and obstruction: colicky pain and symptoms suggesting 'indigestion'.

4. **TUBERCULOSIS (primary).**—Very rare in adults. Diagnosis very difficult. Stools have greater variability. Tubercle bacilli usually found in motions.

Ulcerative Colitis—Diagnosis, *continued*.

SPECIAL METHODS OF DIAGNOSIS.—(1) Sigmoidoscopy; (2) Radiography. Object of these is principally: (a) To ascertain condition of colon and if ulceration is present. (*Note*: Presence or absence of this does not influence treatment.) (b) To exclude neoplasm.

SIGMOIDOSCOPY.—No anæsthetic. Perform with great care. Frequent repetition injurious. All irritation of rectum must be avoided.

RADIOGRAPHY.—Not in acute stages. Colon: haustration absent, colon appears as straight tube; or with irregular segmentation and spasm. Appearance not specific, but confirms diagnosis. Barium enema rarely fails to show neoplasm. Barium meal less definite.

Treatment.—*Essentials*: rest, warmth, sufficient diet. Avoid over-treatment of colon; accept with caution vaunted modes of cure. Treatment, 4 to 12 months.

GENERAL TREATMENT.—Following points of great importance:

1. **WARMTH.**—Especially in acute cases, wrap limbs loosely in cotton-wool; arms to be covered.
2. **FLUID.**—Give freely 1 to 2 oz. every twenty or thirty minutes, in acute stages.
3. **DIET.**—Sufficient nourishment essential. Usually a considerable amount of plain food can be digested, in small amounts at intervals of two and a half hours. Bread or toast, biscuits, butter, eggs, fish, meat extracts and meat jellies, freely; custard, simple proprietary foods and simple milk puddings, suitable; milk not to be used as a beverage or given too largely. Grapes and orange juice to be given. Vegetables: *purée* of spinach and potato, allowable. No meat. Vitamins must be ample.

ACUTE CASES.—Special notes:—

If seen within first twelve or twenty-four hours: saline treatment as in bacillary dysentery.

Diet in early stages: alternate feeds of milk puddings and meat extracts. No alcohol to be given.

TREATMENT BY ENEMATA AND COLONIC WASHES.—In all these, injections must be given through a rubber catheter attached to a funnel or douche-can. Maximum pressure not to exceed 1 ft. above the rectum. Catheter not to be passed more than 3 in. Rate of flow should be a pint in fifteen minutes. The enemata in use correspond roughly to stages in treatment.

Note: If sphincter becomes irritated, rest for at least one week.

Stage 1. STARCH AND OPIUM ENEMATA.—Consist of starch emulsion, 2 to 4 oz., with tinct. opii not exceeding 40 minims. Effect on rectum lasts about twelve hours. Only one injection daily, not more than three days consecutively, nor more than five times a week. Commence with series of three in evenings in order to reduce stools at night. Then give alternate morning and evening series. Continue until number of

stools is reduced by half, or to about five daily. Usual period 2 to 3 weeks.

In early stages there is often marked reaction to opium in enemata. Reduce amount to 5 minims and increase gradually.

Stage 2. COLONIC WASHES.—Consist of water with sodium chloride, 1 drachm to a pint; temperature 98° to 99°; about 2 pints. Will reach cæcum with patient lying on back. Encourage return of wash after interval of 15 minutes from completion, but is harmless if absorbed. Not more than two days consecutively: preferably on alternate days. Continue until number of stools is consistently less than five a day. If stools tend to increase, return to starch and opium enemata, or give these and colonic washes alternately. In severe cases, second stage usually lasts 6 to 8 months.

Stage 3. MEDICATED ENEMATA.—Contain organic silver preparation, e.g., albargin, 20 to 30 gr., in 30 oz. of normal saline. Two hours previously give simple colonic wash, as above: at least half must be returned before medicated enema. Medicated enema must not be retained more than fifteen minutes. Never give more frequently than alternate days, with at least one week's interval after each six. If stools increase in frequency, return to *Stage 2* for a period. *Stage 3* usually lasts 2 to 3 months.

DRUGS.—Morphia should never be given except in enemata.

Bismuth salicylate, *mistura cretæ*, and aromatic sulphuric acid may be given. Charcoal and kaolin are harmless.

SERUM THERAPY.—Improvement very rare (not specific, is due to protein shock): considerable reaction and not devoid of risks.

VACCINE THERAPY.—Useless.

SURGICAL TREATMENT.—Indicated by incontinence, but not otherwise. Appendicostomy and cæcostomy: often immediate relief, but after-results poor. Closure of opening rarely possible.

AFTER-TREATMENT.—Diet: no roughage. For bowels, liquid paraffin.

VI. MUCO-MEMBRANOUS COLITIS: MUCOUS COLITIS.

Chronic condition of colon associated with: (1) Neurasthenia and neuroses; (2) Constipation; (3) Passage of mucous casts resembling membranes. Now rare.

Etiology.—

AGE OF ONSET.—20 to 40 years. *Duration*, often many years.

SEX.—Five females to one male.

CAUSATION.—*No inflammation of colon.* Productions of casts may be explained by excessive secretion of mucus, together with constipation, the resulting delay in evacuation permitting time for coagulation of mucin by mucinase of intestinal mucous membrane (cf. BRONCHIAL ASTHMA).

Muco-membranous Colitis—Etiology, continued.

TYPE OF PATIENT.—Thin anæmic woman, muddy complexion, poor appetite, some visceroptosis. Neuroses marked feature.

Symptoms.—Patient's life consists of:—

1. Periods of freedom: sometimes months. Health poor. Constipation invariable.
2. Periods in which attacks occur. Few days to several months. Onset often follows worry, or error of diet.

SYMPTOMS DURING ATTACKS.—

1. **CONSTIPATION.**—Obstinate. May be attacks of diarrhœa.
2. **PAROXYSMAL ATTACKS.**—(i) *Colic*: colon palpable as cord in left iliac fossa; (ii) *Passage of membranes*, usually occurs after several paroxysms; (iii) *Tenesmus*, with membranes, severe.

Stool: fecal matter as scybala or flat ribbons (anal spasm). Mucus may be: (a) In masses or strips. (b) 'Membranes': (i) All shapes from strips to tubular casts of colon; (ii) Gelatinous appearance, smooth outside, rough inside, described by patient as 'skins'; (iii) Always mucoid, never epithelial.

Intestinal sand: common in severe cases: several drachms.

Complications and Associated Diseases.—

NEUROSES.—Introspective as to bowels. Membranous dysmenorrhœa in 10 per cent.

HÆMORRHOIDS.—Common; removal no cure of colitis.

Diagnosis.—Appendicitis may be simulated. Mucus in excess, and also 'membranes', occur in other forms of colitis, occasionally in *cancer of colon or rectum*, and in tubo-ovarian diseases.

Prognosis.—Not fatal. Improves on treatment, tends to recur. Final result depends on degree of neurosis.

Treatment.—Indications are to treat: (1) Nervous manifestations; (2) Constipation; and (3) Colon.

NERVOUS MANIFESTATIONS.—Bed, one to two weeks or more, at beginning of treatment. Bromides, belladonna.

CONSTIPATION.—Simple aperients: senna pods, agar-agar, liquid paraffin. Olive oil injection at night, if tenesmus (retain overnight). *Massage. Abdominal exercises.*

COLONIC IRRIGATIONS.—Two or three treatments every 4 to 6 weeks, e.g., Plombières douche. At onset of treatment, may be more frequent temporarily: viz., simple colonic wash, sod. chlor. 2 pints.

DIET.—Simple ordinary diet is best. At Plombières, simple diet is given. Some recommend coarse foods.

SPAS.—Plombières, Harrogate. Standard treatments valuable.

BETWEEN ATTACKS.—Regular life and exercise. Aperients to be avoided if possible, especially saline. Safe and best are: paraffin. liq. ʒss to ʒj, bis die; infusion of senna pods; castor oil ʒss to ʒj. Abdominal belt may give relief.

VII. DIARRHŒA IN CHILDREN.

Etiology.—

AGE.—Commonest 6 to 18 months, especially about dentition.

SEASON.—Maximum in summer: depends on sultry weather.

DIET.—Important factors are: (1) *Bottle-fed infants* very susceptible; (2) *Overfeeding*, acts by direct irritation, and also by increasing fermentation; (3) Excess of fat.

In older children, special articles, e.g., over-ripe or unripe fruit.

MILK.—Contamination. Unclean utensils.

ENVIRONMENT.—Dirt, squalor, and lack of fresh air.

EPIDEMICS.—Common in institutions.

OTHER FACTORS.—(1) Chills; (2) Teething; (3) Rickets.

Bacteriology.—*In epidemic and summer diarrhœa*, various organisms in different epidemics, especially non-lactose fermenters, e.g., proteus, Gaertner, dysentery Flexner and Sonne, 'Morgan's No. 1', also streptococci and staphylococci. 'Morgan's No. 1 Baccilus' common in Great Britain, but causal relationship unproved.

Morbid Anatomy.—*In intestines*: Changes, often slight even in severe forms.

SIMPLE DIARRHŒA.—Congestion and slight thickening of the mucous membrane.

ACUTE GASTRO-ENTERITIS.—Mucous membrane *thin and atrophied*; solitary lymphoid follicles increased. Often no other marked change. Occasionally, increased redness or small ulcers. *In other organs*, may be: (1) Fatty liver; (2) Bronchopneumonia.

CLINICAL GROUPS.

(1) Simple non-inflammatory diarrhœa. (2) Acute gastro-enteritis or enterocolitis: inflammatory diarrhœa: also known as *epidemic or summer diarrhœa*. (3) Choleraic diarrhœa: infantile cholera. Is fulminating form of last group.

Note.—Chronic diarrhœa—e.g., cœliac disease, tuberculous enteritis—is not here referred to.

1. Simple Diarrhœa.—Usually from errors of diet, or from chill.

ONSET.—Often preliminary symptoms. Restlessness. Abdominal colic: legs drawn up and abdomen hard.

PYREXIA.—Slight.

VOMITING AND DIARRHŒA.—Motions 2 to 10 daily. Stools: offensive or sour, undigested food present, mucus in later stages, colour light brown to green.

PROSTRATION.—Usually moderate, but severe in feeble children.

DURATION.—Usually few days. May pass into severer types in summer. Tendency to recurrence or to gastric disturbance subsequently.

NOTES.—*Green colour of stools* is variously ascribed to presence of bile pigment, from rapidity of peristalsis; to conversion of stercobilin into biliverdin by bacilli; and to chromogenic bacilli.

Diarrhœa in Children—Simple Diarrhœa, continued.

'*Lienteric Diarrhœa*'.—Motion follows taking of food. Usually in older children, 5 to 6 years, and subacute. Much undigested food in stools. Wasting occurs, and results may be severe from lack of nutrition.

2. Acute Gastro-enteritis.—Summer or epidemic diarrhœa.

ONSET.—Sudden, may be convulsion or twitchings.

VOMITING.—Rarely absent, often persistent.

DIARRHœA.—Stools numerous. Straining severe. At onset fœcal, then watery: mucus usual but blood uncommon. Prolapse of rectum frequent, and excoriation round anus.

ABDOMINAL PAIN AND TENESMUS.—Legs drawn up, and abdomen hard; but later with collapse, often becomes lax.

TEMPERATURE.—Usually 103° to 105° . Hyperpyrexia not infrequent.

WASTING, EXHAUSTION, AND COLLAPSE.—Rapid and very severe. Face pinched, eyes hollow, fontanelles depressed. Shrunken appearance. Dry skin. Cold and cyanotic though rectal temperature high. *Skin lax and inelastic*. Passes from early restlessness to condition of extreme collapse, with feeble 'meningeal' cry. Vomiting and even diarrhœa may cease.

THIRST.—Extreme. *Urine scanty*. *Stomatitis* frequent.

Course.—May be death in few hours, from collapse or hyperpyrexia. Acidosis may develop rapidly. Acute symptoms usually last 2 to 3 days: may be rapid improvement or more frequently becomes subacute with marasmus, subsequent tedious recovery, or relapse. Bronchopneumonia serious.

MORTALITY.—High.

CONVALESCENCE.—Very slow. Tendency to relapse, and to chronic diarrhœa.

3. Choleraic Diarrhœa.—Infantile cholera. Fulminating form of above. Rice-water stools. Collapsed state occurs with great rapidity. Mortality very high.**TREATMENT.**

Prophylaxis.—Of great importance: (1) Avoid weaning in hot months; (2) Protect against chills; (3) Utmost cleanliness of bottles and teats; (4) Pasteurization of milk; (5) Amount of fat and strength of milk reduced on any intestinal disturbance; (6) Fresh air and attention to general health.

General Outline of Treatment.—Indications: (1) Remove source of infection; (2) Treat collapse; (3) Neutralize toxins; (4) Arrest diarrhœa and vomiting.

HYGIENE.—Avoid chills, but good ventilation of rooms. Warm clothing, especially of extremities. Flannel abdominal binder. Sponging instead of bath.

DIET.—Only albumen water for twenty-four to forty-eight hours. Then barley water, weak tea, or whey with glucose. As the condition improves, Mellin's food may be added to whey, or

meat juice given. Milk with lime-water or barley-water to be commenced with caution.

FLUIDS.—Freely. In addition to above, boiled water in small amounts (3j) frequently, every 15 minutes, as indicated.

DRUGS.—

1. *Initial dose* of castor oil if seen *early in attack*: single dose up to 3j, or small doses repeated in mild cases, viz.,

R	Ol. Ricini	℥v	|	Aq. Carui	ad 3j
	Mucil. Acaciæ	℥x	|		

Every four hours. (Aids removal from intestine of irritating contents.)

2. Bismuth, chalk, and astringents (tinct. catechu) in various forms and combinations are the most efficient drugs. For child of 1 year:—

R	Bism. Oxycarb. gr. iiss to v	|	Glycerini	℥v to x
	Pulv. Cret. Aromat.			
	c. Opio gr. j to ij	|	Aq. Anethi	ad 3j
	Tinct. Catechu ℥iiss to v	|		

Every 4 hours.

Of intestinal antiseptics, calomel only is of accepted value.

Best when combined with Dover's powder:—

R	Calomel	gr. ½		Pulv. Ipecac. Co.	gr. ½
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Repeated every 4 hours, not exceeding calomel gr. j. in 24 hours.

3. Starch and opium enema (starch emulsion 3ss, tinct. opii ℥ij). Twice daily if diarrhoea severe.
4. Choleraic Type: Inject morphine (gr. ʒʒ at one year).

Note: A child should not be awakened for a dose containing opium.

COLONIC IRRIGATION.—May check diarrhoea. Normal saline. With hyperpyrexia, cold or ice-cold water may be used.

COLLAPSE.—Inject sterile saline and glucose solutions subcutaneously: 4 to 10 ounces repeatedly. *Intraperitoneal injections* are very rapidly absorbed, and with the lax skin are easily performed. Or intravenous injections. Stimulants: Brandy 3ss to 3j in twenty-four hours. For acute collapse, mustard baths.

APPLE DIET.—Good results occasionally. Ripe raw apples, pulped and sieved: one to two tablespoonfuls of pulp every 2 hours for 48 hours. No other food.

VOMITING.—Wash out stomach, with catheter and funnel.

AS CONDITION IMPROVES.—Gradual increase of diet, avoiding cream, and sparing milk. With undigested food in stools, repeat castor oil or calomel.

VIII. APPENDICITIS.

Etiology.—

AGE.—Nearly 50 per cent before 20 years of age. Rare before 5 years.

SEX.—Incidence equal.

RACE.—Especially among civilized races.

Appendicitis—Etiology, continued.

POSITIONS OF APPENDIX.—In order of frequency : (1) To left of cæcum, in iliac fossa. (2) Hanging over brim of pelvis; important position from reference to pelvis of symptoms and signs. (3) In retrocolic and ileocæcal fossa : especially common in disease. (4) To right of cæcum.

ACUTE APPENDICITIS.

Symptoms.—(1) Sudden onset of abdominal pain, settling in right iliac fossa ; (2) Fever and rapid pulse ; (3) Nausea, vomiting, and constipation ; (4) Tenderness in right iliac fossa.

PAIN.—Cardinal symptom. Onset usually sudden. At onset often central and diffuse, later settling in right iliac fossa. Either sharp and severe, or a dull ache. Rarely in left iliac fossa.

RETROCÆCAL APPENDIX.—Pain may be in right flank.

PELVIC APPENDIX.—Bladder and rectum irritated (diarrhœa).

FEVER.—Some degree extremely constant. Moderate, rarely exceeding 102°. May be absent in : (1) Localized abscess already formed ; (2) Severe general peritonitis (other signs definite). Rigors not common at onset.

PULSE.—Increase roughly proportional to temperature. Most valuable measure of progress : *increasing rapidity is a serious sign.*

GASTRO-INTESTINAL DISTURBANCES.

TONGUE.—Furred and moist ; rarely dry.

VOMITING.—May be absent. Rarely after second day if mild attack ; persistence points to serious lesion.

CONSTIPATION.—Usual. Diarrhœa occasionally in children.

Abdominal Signs.

INSPECTION.—No alteration in earliest stages. Lack of movement develops on right side, especially in lower half.

PALPATION.—(1) Increased resistance or definite rigidity of right rectus. (2) Deep tenderness at McBurney's point ; most definite sign. (3) Often, an ill-defined swelling in right iliac fossa, mainly adherent coils of intestine and omentum surrounding inflamed appendix ; occasionally a definite tumour from a pre-formed abscess. May be hyperæsthesia of skin in right iliac fossa (absent if appendix perforates) and occasionally œdema.

McBURNÉY'S POINT.—Situated on line from umbilicus to anterior superior spine of ilium, at outer edge of rectus. Corresponds to base of appendix.

VARIOUS PHENOMENA.—Right leg is often semiflexed. Irritability of bladder may be early symptom. With appendix hanging over brim, symptoms suggest pelvic disease.

RECTAL EXAMINATION.—Usually nothing felt in early stages, but occasionally in pelvic position of appendix abdominal signs may be slight, with tender mass palpable by rectum, and rectal wall œdematous on right.

Leucocytosis.—In mild cases, may be none. In acute cases, very constant: 12,000 to 15,000 leucocytes, with increased percentage of polynuclear cells.

Progress and Result of Attack.—May be: (1) Recovery; (2) Appendix abscess formation; (3) General peritonitis.

'APPENDIX ABSCESS.'—Progress of inflammation and formation of pus may be limited by interperitoneal adhesions, an 'appendix abscess' thus resulting.

DIAGNOSIS OF ABSCESS FORMATION DURING ATTACK.—

(1) Increase in resistance, and tumour in right iliac fossa (or per rectum); (2) Constitutional symptoms more marked, especially rapid pulse and leucocytosis. Temperature usually rises, but may be moderate; may be sweats.

SITES OF ABSCESS.—(1) In iliac fossa, roof formed by abdominal wall; (2) In pelvis, palpable through rectum or vagina; (3) Retrocolic; (4) In right flank.

GENERAL PERITONITIS.—May result from: (a) Acute perforation of appendix; (b) Rupture of appendix abscess.

It is essential to note that, at and from the onset, peritonitis may be present and be extending without any symptoms differentiating it from a mild catarrhal attack: also that an appendix may perforate or be gangrenous with previous symptoms mild or of short duration. Hence decision not to operate immediately in any case of acute appendicitis is justified only when the patient can be watched continually and operated upon without delay, and is justified in no other circumstances.

Complications and Sequelæ.—

1. APPENDIX ABSCESS.

2. GENERAL PERITONITIS. } See above.

3. SUPPURATIVE PYLEPHLEBITIS. — Inflammation may commence in veins near appendix, resulting in: (i) Portal pyæmia: tender and enlarged liver, phenomena of severe sepsis. Usual sequela. Always fatal. (ii) Subphrenic abscess. (iii) Occasionally thrombosis, partial or complete, of superior mesenteric vein, with gangrene of gut. Initial attack of appendicitis often slight or overlooked. Diagnosis difficult and mortality high.

4. SUBPHRENIC ABSCESS.—Usually from tracking of pus. Moderate irregular prolonged temperature, increased pulse-rate, symptoms of sepsis, frequently signs at base of right lung (see SUBPHRENIC ABSCESS).

Also abscess in pelvis and other sites.

5. COLITIS.—If present with onset, may persist for long periods.

6. RECURRENT ATTACKS.

7. ADHESIONS.

8. GENERAL SEPTICÆMIA.—Occasionally.

9. HÆMORRHAGE.—Occasional, e.g., perforation of internal iliac artery.

Diagnosis.—Justified by: (1) Sudden localizing pain in right iliac fossa; (2) Rigidity in right iliac fossa; (3) Deep tenderness at

Acute Appendicitis—Diagnosis, continued.

McBurney's spot; (4) Fever; additional symptoms being vomiting, furred tongue, constipation, rapid pulse, and also, if appendix be distended, superficial tenderness.

DIAGNOSIS FROM:—

1. VARIOUS CAUSES OF PAIN IN RIGHT SIDE.—(1) Renal colic; (2) Biliary colic; (3) Menstrual pains (no fever); (4) Arthritis and pain from hip-joint, specially in children; (5) Vertebral disease.
2. DISEASE OF FALLOPIAN TUBES AND PELVIC PERITONITIS.
3. ENTERIC FEVER.—Onset may suggest appendicitis. *Rarely* appendix ulcerates in third week, and may perforate.
4. THORACIC DISEASES.—Acute pneumonia, right base: pain at onset may be referred to iliac fossa, especially in children. Also acute pleurisy, intercostal neuralgia.
5. LOCAL PERITONITIS.—Due to other causes, e.g., tuberculosis: diagnosis often possible at operation only.
6. PERINEPHRIC ABSCESS.
7. COLITIS AND MUCOUS COLITIS.
8. HYSTERICAL SIMULATION AND HYPOCHONDRIASIS.
9. HERPES ZOSTER.—*Rarely*.

APPENDIX ABSCESS.—Formation accompanied by: (1) Increase in tumour; (2) Constitutional symptoms of sepsis. Rupture marked by shock, collapse, sudden diffuse abdominal pain, progress of general peritonitis.

GENERAL PERITONITIS.—Abdominal pain and tenderness, distension, and rigidity; pulse rising, and usually temperature; also Hippocratic facies, constipation.

Treatment.—*Operation at earliest moment (see p. 471.)*

Between time of diagnosis and operation in acute cases, place in the Fowler position, water only by mouth, no aperients or enemata: morphia allowable after diagnosis while awaiting immediate operation.

Interim appendicectomy for one definite attack, however mild, or for repetition of a mild and doubtful attack.

CHRONIC APPENDICITIS.

Types.—Many clinical types are included under chronic appendicitis.

1. RECURRENT APPENDICITIS.—Recurrent attacks.
2. SUBACUTE OR RELAPSING APPENDICITIS.—Symptoms persist with exacerbations. May be no acute attack, but discomfort, pain, and tenderness in right iliac fossa. Symptoms vary considerably.
3. CHRONIC APPENDICITIS.—Gastric symptoms, with or without discomfort in right iliac fossa.

EPIGASTRIC PAIN.—May radiate to umbilicus, less often to right iliac fossa; time of onset irregular; heartburn uncommon; not relieved by food, alkalis, or treatment. Nausea frequent; vomiting. Constipation or diarrhoea.

EXAMINATION.—May be entirely negative. Pressure on right iliac fossa may cause (a) discomfort at site, or (b) discomfort in epigastrium.

BASTEDO'S SIGN.—Inflation of colon through rectal tube may cause pain in appendix region.

RADIOGRAPHS.—(1) Appendix not visualized; consistent with blockage. (2) Appendix fills, and defects may be visible; shadow persists after remainder of meal has passed. Cæcum and terminal ileum fixed by adhesions.

Morbid Anatomy.—Appendix distorted and fixed by adhesions. Lymphatic glands enlarged at root of appendix and in mesentery.

Treatment.—Appendicectomy, if recurrent subacute attacks. For chronic form only if fully confirmed: may fail to cure symptoms.

Diagnosis.—Similar symptoms occur in visceroptosis, constipation, especially in neurotic subjects, and other similar conditions. Abdominal operations are inadvisable in such, even with diagnosis of chronic appendicitis, as further operations are almost invariably demanded.

IX. INTESTINAL OBSTRUCTION.

A condition in which the flow of intestinal contents is impeded partially or completely by causes of comparatively local extent. Finally even the passage of flatus ceases. The condition may be: (1) Acute; (2) Chronic; (3) Acute supervening on chronic.

ETIOLOGY.

General Causes.*—

CAUSES OUTSIDE THE INTESTINE.—(1) Strangulation by bands, adhesions, and apertures; (2) Volvulus; (3) Paralytic ileus, rare; (4) Pressure of tumours, rare.

CAUSES IN THE INTESTINAL WALL.—(1) Intussusception; (2) Tumours; (3) Strictures; (4) Idiopathic dilatation of the colon.

CAUSES WITHIN THE LUMEN.—(1) Impacted fæces; (2) Gall-stones and other foreign bodies.

Respective Causes of Acute and Chronic Obstruction.—The common causes of acute and chronic obstruction respectively are not identical. They are as follows:—

ACUTE INTESTINAL OBSTRUCTION.—Common causes: (1) Strangulation; (2) Intussusception; (3) Volvulus; (4) Gall-stones (uncommon); (5) Chronic forms becoming acute. Rarely: paralytic ileus (blockage of mesenteric arteries, etc.), tumours, strictures.

CHRONIC INTESTINAL OBSTRUCTION.—Common causes: (1) Tumours in wall; (2) Strangulation; (3) Strictures; (4) Impacted fæces. Rarely: pressure of outside tumours, chronic intussusception, idiopathic dilatation of colon.

* By general agreement, the sequelæ of external herniæ are not included in the term 'intestinal obstruction.'

Intestinal Obstruction, *continued*.

SYMPTOMATOLOGY.

General Symptoms.—

A. ACUTE INTESTINAL OBSTRUCTION.—

1. ABDOMINAL PAIN.—Early, often sudden, severe, at first colicky, then continuous.
2. VOMITING.—Early and constant symptom; repeated; *often copious*. Character of vomit important, first stomach contents, then bilious, finally faecal.
3. CONSTIPATION.—Absolute for faeces and flatus after few hours, bowel below obstruction sometimes emptying itself at onset. Often desire but inability to pass flatus.
4. COLLAPSE.—Shock at onset progressing to collapse; face pale and pinched; low temperature, rapid feeble pulse, cold sweat, dry tongue, and thirst. May be hiccup.
5. ABDOMEN.—In early stage, little change; *moderate distension, doughy feel*, variable tenderness, often slight; no peristalsis. Later, distension and tympanites (depending on cause), rigidity and extreme tenderness. Tumour rare, except in special conditions.

PYREXIA.—Usually absent. Temperature often subnormal; may rise with peritonitis, or remain low owing to collapse.

DEATH.—In 3 to 6 days in absence of operation. In later stages, peritonitis present.

B. CHRONIC INTESTINAL OBSTRUCTION.—Abdominal attacks similar to acute, but milder, and extending over a period of months or years: severity of symptoms varying and gradually advancing.

1. PAIN.—Colicky, intermittent.
2. VOMITING.—Slight or absent, may follow food. Not faecal.
3. GENERAL WEAKNESS.—Anæmia, wasting, and ill-health.
4. CONSTIPATION.—Partial: attacks of diarrhoea with mucus, from irritation of scybala above obstruction; sometimes tenesmus; may be morning diarrhoea.
5. ABDOMEN.—(i) *Distended*; (ii) *Visible peristalsis* and coils of gut; (iii) Often palpable tumour.

RECURRENT ATTACKS of severer obstruction, symptoms approaching acute form, with marked visible peristalsis; increasing in severity, duration, and frequency.

C. ACUTE SUPERVENING ON CHRONIC OBSTRUCTION.—

The symptoms of acute obstruction with the history and abdominal signs of chronic obstruction.

Notes on Symptoms.—

VOMITING.—The higher the obstruction, the greater is the vomiting.

FÆCAL VOMITING.—Intestinal contents putrefy and thus become 'faecal' above the obstruction: they are not transferred from below. Never consists of formed faeces.

TYMPANITES.—Due to stoppage of blood-supply, not to blocking of lumen. Hence absent in gall-stone impaction and present in thrombosis of mesenteric arteries: marked and rapid in strangulation of large loops, more especially volvulus. In later stages depends on peritonitis.

TENDERNESS AND RIGIDITY.—Not present in early stages in acute form, except in volvulus (from distension). Is due to peritonitis.

TENESMUS.—In colonic obstructions.

PERISTALSIS.—Often best seen after food, or abdominal stimulation by flicking or pressure of finger-tips.

CERTAIN SPECIAL TYPES.

Strangulation of a Loop of Gut.

Commonest cause of acute obstruction (35 per cent), though infrequent in youth: usually in small gut.

1. **ADHESIONS, BANDS, AND APERTURES.**—Usually from former peritonitis, or result of operations. Meckel's diverticulum may be adherent, usually near navel. Adhesions may form very rapidly, and cause obstruction within a few days of appendicectomy and similar operations.
2. **PERITONEAL POUCHES AND INTERNAL HERNIÆ.**—All rare. Strangulation in (i) Foramen of Winslow; (ii) Peritoneal pouches.

Diaphragmatic Hernia.

Orifice may be: (i) Congenital; (ii) Acquired, by stabs, crushes, etc. Very rare on right (owing to liver). Hernia may enter: (1) Pleuro-peritoneal hiatus, into pleura, e.g., 'thoracic stomach'. (2) Œsophageal hiatus, i.e., 'para-œsophageal hernia'.

CONTENTS.—Stomach commonly: less often small intestine; omentum, colon.

INTERMISSIONS AND EXACERBATIONS.—Symptoms depend on amount of viscera in hernia and degree of obstruction, both of which vary. At times none, and hence no symptoms or signs. Acute or subacute obstruction, temporary or permanent, may develop with corresponding symptoms.

SYMPTOMS.—

1. **ABDOMINAL.**—Pain or discomfort, flatulence, nausea, vomiting: often affected by position of body, also by food.
2. **THORACIC.**—Hiccup, cough, dyspnœa; may be pain in left shoulder; palpitation.

PHYSICAL SIGNS.—

ANTERIOR.—Stomach resonance increased upwards. Heart may be displaced.

POSTERIOR.—Left base: tympanitic, breath-sounds and fremitus diminished.

Intestinal Obstruction—Diaphragmatic Hernia, continued.

ACQUIRED FORM.—(1) Onset sudden: shock and dyspnoea.
(2) Onset gradual: as above.

DIAGNOSIS.—From pneumothorax, eventration of diaphragm; occasionally intestinal and pyloric obstruction.

RADIOGRAPHS.—Usually conclusive, with special care in oblique positions.

TREATMENT.—Operation.

Intussusception.

“The passing of one portion of intestine into another” (John Hunter).

SYMPTOMS.—The patient is commonly a plump, well-nourished, healthy infant under one year, generally male.

ONSET.—Sudden.

CHARACTERISTICS.—

1. *Abdominal Pain.*—Intermittent. Infant draws up legs and cries during spasm.
2. *Vomiting.*—At onset, then ceases. Rarely faecal.
3. *Stools.*—(i) Tenesmus; (ii) Blood and mucus (from congestion of gut). *Bile absent* after few motions: also faecal matter. Quantity small. *Examine per rectum* for presence of tumour and blood on finger, when in doubt.

PHYSICAL SIGNS.—

ABDOMEN.—In early stages appears normal, no distension palpation often induces spasm.

TUMOUR.—Sausage-shaped, diameter one inch, length variable; in course of colon; often near left costal margin. Present in 70 per cent.

DIAGNOSIS.—Usually easy on symptoms. Diagnose from colitis. Also anaphylactoid purpura, rare (may coexist).

Chronic Intussusception.—Usually adults or old persons: from invagination of malignant or polypoid growth. Type usually *colic* or *ileal*.

SYMPTOMS.—Chronic obstruction, recurrent irregular attacks of colic and vomiting with bloody diarrhoea or constipation. May be visible peristalsis and dilatation above obstruction. *Tumour* often palpable. Per rectum, sphincter relaxed. Onset may be acute, subsiding into chronic. *Radiographs*: Barium enema may show lesion.

TERMINATION.—(1) Acute obstruction; (2) Perforation; (3) Occasionally presents at rectum.

DURATION.—A month to a year or more. *Diagnosis* rarely made.

Volvulus.

A twist of a loop of gut. Due to an abnormally long loop with a long, narrow mesenteric pedicle: twists on long axis, or rarely about another loop; chronic constipation also a factor. *Sites*: (1) Sigmoid 50 per cent: (2) Cæcum; (3) Occasionally small intestine and other positions.

ETIOLOGY.—

AGE.—Rare under 30 years.

SEX.—Males 70 per cent.

FREQUENCY.—In adults, is next to strangulation as cause of acute obstruction.

SPECIAL SYMPTOMS.—(1) *Abdominal distension and tympanites early and extreme.* Rapid distension is due to occlusion of blood-supply to large loop, and accumulation of gas. Also peritonitis and gangrene occur early. (2) Vomiting usually late.

Impacted Fæces.

(See DILATATION OF THE COLON, p. 484.) Fæces accumulate in colon : associated with atony of muscular wall ; distention may be enormous. Occurs at any age, especially elderly females. Common cause of chronic obstruction ; *never acute initially.*

Gall-stones.

Rare cause of acute obstruction, but mortality high ; never chronic.

ETIOLOGY.—(1) Age and sex : stout elderly females. (2) Previous history : colicky attacks, vomiting and dyspepsia ; occasionally but rarely jaundice.

PATH OF STONE.—To cause obstruction stone must have diameter of one inch. Usually ulcerates into duodenum through adherent gall-bladder (if into colon, stone can be passed). Passage through bile-ducts is recorded.

SITE OF OBSTRUCTION.—Near ileocaecal valve.

SPECIAL SYMPTOMS.—(1) Vomiting constant, copious, and early *fæcal*, owing to high obstruction. (2) Symptoms intermit, with passage of fæces and flatus. (3) Shock slight at first, as mesentery not affected : collapse about fourth day. Rarely lodges in duodenum, with vomiting of enormous quantities.

Mortality from operation high, owing to age and lateness of diagnosis and operation, due to intermission of symptoms.

Paralytic Ileus.

Paralysis of muscular walls may follow any abdominal shock, viz., abdominal operations and injuries, peritonitis, embolus or thrombosis of mesenteric arteries, rarely paracentesis ; pneumonia, pleurisy, rarely heart disease. Also in hysteria.

Embolism of Mesenteric Arteries.—

SPECIAL SYMPTOMS.—Vomiting, constipation, *great abdominal distension*, occurring with heart disease ; rarely melæna. Peritonitis and gangrene early from poverty of anastomosis.

DIAGNOSIS OF ACUTE OBSTRUCTION.

Diagnosis may be difficult, since stimulation of the abdominal sympathetic produces similar results whatever the cause may be.

Intestinal Obstruction—Diagnosis, continued.**Other Conditions Simulating Obstruction.—**

1. ORGANIC OBSTRUCTIONS, i.e., EXTERNAL HERNIÆ.—Examine the various rings.
2. PERITONITIS.—Especially *appendicitis*, also *ruptured peptic ulcer*. Note: (a) Abdomen rigid, tender, and early distended; (b) Vomiting, amount small* and never distinctly fecal; (c) Pyrexia.
3. GASTRO-INTESTINAL IRRITATION.—Acute enteritis. Generally distinguished by diarrhoea. From intussusception by less sudden onset, bile in stools, no tumour.
4. SENSORY STIMULATION OF ABDOMINAL SYMPATHETIC AND ALLIED CONDITIONS.—Renal and biliary calculi; movable kidney (Dietl's crises); twisted ovarian tumour (previous or palpable tumour); torsion of testis (one testis absent). Rarely, embolism or thrombosis of mesenteric arteries, i.e., condition of *paralytic ileus*.
5. ACUTE HÆMORRHAGIC PANCREATITIS.—Note: Very rapid collapse, feeble pulse, and distension high in abdomen; constipation not absolute.
6. CONDITIONS ASSOCIATED WITH CONSTIPATION AND SOMETIMES VOMITING.—Include: (i) Enteric, occasionally pneumonia; (ii) Tabetic crises; (iii) Lead colic; (iv) Uræmia; (v) Cancer of stomach (vomiting, tumour, and constipation). Note: (a) Vomiting not fecal; (b) Constipation not absolute; (c) No shock.

Site of the Obstruction.

SMALL INTESTINE.—(1) Vomiting early, copious, and fecal; (2) Distension central, parallel peristaltic coils, 'ladder pattern' (especially if near cæcum); (3) Symptoms acute, rapid collapse.

LARGE INTESTINE.—(1) Vomiting later; (2) Distension and peristalsis may be in line of colon; (3) Tenesmus, passage of blood and mucus, suggest colon; (4) Course and collapse often slower.

Nature of the Obstruction.—Often impossible to decide.

IN INFANTS.—Nearly always intussusception.

STRANGULATION BY BANDS, ETC.—Previous operation and attacks.

VOLVULUS.—Elderly males in previous good health; rapid extreme abdominal distension; vomiting later.

TUMOURS.—Previous history of wasting; presence of tumour; peristalsis.

GALL-STONES.—Elderly females; previous colic; early copious vomiting, but collapse slower.

FÆCAL OBSTRUCTION.—Fæces often palpable per rectum, colonic distension.

EXAMINATION.—Note: (1) Hernial rings; (2) The rectum for tumour, ballooning, and relaxation of sphincter; (3) Vagina; (4) In chronic cases, radiography.

* It has been said that a patient with intestinal obstruction vomits into a basin, and with peritonitis into a soap dish.

TREATMENT.

Acute Obstruction.—Operation without delay.

Chronic Obstruction.—Immediate operation except in the case of *fæcal impaction*.

FÆCAL IMPACTION.—Remove if possible per rectum. Warm olive-oil enema followed by soap and water, then remove with spoon. Repeated enemata, and careful abdominal massage. Operative treatment gives poor results (removal of mass through incised gut).

X. CONSTIPATION.

Delay in evacuation of fæces. Motions less frequently than once in forty-eight hours constitute constipation.

Note.—Much apparent and self-diagnosed constipation is due to erroneous use of aperients. Before accepting diagnosis, stop all aperients and observe results: great improvement or sufficient motions may follow. Many subjects—e.g., of visceroptotic type—are at maximum health with about five motions weekly; constant attempts with aperients to produce traditional daily motion are more harmful; such persons should attempt a daily motion, but should not take aperients to obtain it.

Etiology.—The principal factors in peristalsis and in evacuation of fæces are: (1) Abdominal muscles and diaphragm; (2) Intestinal wall, both muscle and mucous membrane, and reflex nervous mechanism; (3) Intestinal contents. In 'organic constipation' another factor exists: (4) Obstruction to intestinal contents. The causes of constipation are numerous. They may be classified as: (A) General causes; (B) Local causes, involving mainly one of the above factors. Some overlapping occurs.

The small intestine is not an appreciable factor.

A. General Causes.—

HEREDITY.—Not uncommon in families.

SEDENTARY LIFE.

NEGLECT OF CALL OF NATURE.—Attempt at a motion should be made regularly daily at same hour, even in absence of obvious call. Is partly a conditioned reflex.

VARIOUS DEBILITATING CONDITIONS—e.g., (i) Fevers; (ii) Anæmia; (iii) Neurasthenia (*see also* VISCEROPTOSIS, p. 482).

SENILITY.

DRUG HABITS.—Especially morphia.

HYSTERICAL CONSTIPATION.

B. Local Causes.—

1. WEAKNESS OF VOLUNTARY MUSCLES (abdominal and diaphragm).—Action of these: (a) Contractions stimulate peristalsis of gut; (b) Contraction during defæcation raises intra-abdominal pressure. Chronic relaxation allows distension and debility of viscera.

Constipation—Local Causes, continued

The weakness may be associated with: (i) Obesity; (ii) Repeated pregnancies; (iii) Sedentary life; (iv) Viscerogptosis; (v) Chronic emphysema (diaphragm fixed); (vi) Senility; (vii) Ruptured perineum (levator ani).

2. AFFECTIONS OF THE INTESTINAL WALL AND NERVOUS MECHANISM.—

AFTER DIARRHŒA AND PURGATIVES.—Reflex from mucous membrane deficient; also increased absorption of fluid.

DISEASES OF STOMACH.—Impaired normal stimulus of gastro-colic reflex.

ATONY OF COLON.—Results from prolonged constipation (*see* HIRSCHSPRUNG'S DISEASE, p. 485).

NERVOUS MECHANISM.—Stimulation of the sympathetic system (inferior hæmorrhoidal plexus) inhibits peristalsis, i.e., *ileus* follows.

LEAD.—Acts on sympathetic, and also on vagus, causing spasm.

ENTEROSPASM.—Spasm of portion of intestine, especially sigmoid flexure. Usually with: (i) Ulcerative or mucomembranous colitis; (ii) Neuroses. Spasm simultaneously of anus often causes ribbon-shaped fæces.

3. CHARACTER OF INTESTINAL CONTENTS.—

DIETETIC.—Numerous factors, e.g.: (i) Diet unstimulating deficient in articles leaving a residue; also in salts causing peristalsis, e.g., vegetables, fruit. (ii) Diet insufficient: starvation. (iii) Fluid insufficient.

OVER-ABSORPTION IN INTESTINE.—'Greedy colon'. Digestion and absorption of fluid may be excessive.

4. OBSTRUCTION TO INTESTINAL CONTENTS.—Practically identical with causes of intestinal obstruction.

Note.—The theory of intestinal stasis due to 'kinks' is now completely abandoned.

Types of Constipation.—Constipation—viz., reduction in number of motions—may be due to: (1) Slow passage through intestines to rectum; (2) Delay and difficulty in emptying rectum ('dyschezia'). *Normal rate of passage* through intestine is: From ingestion of food to cæcum $4\frac{1}{2}$ hours, hepatic flexure $6\frac{1}{2}$ hours, splenic flexure 9 hours, enters pelvic colon 12 hours, enters rectum 18 hours. In group (1) delay is in colon, the rectum being normally empty: delay in passage through small intestine is rare in constipation except with weak abdominal muscles. In group (2) passage to pelvic colon is normal or at increased rate. The delay is in emptying rectum, which constantly contains hard fæces. In this group, when uncomplicated, purgatives are of little use and enemata are indicated. The factors of both groups not uncommonly coexist (Hurst).

Symptoms.—General moderate depression of functions. Health often fair with chronic constipation.

APPEARANCE.—Complexion muddy, conjunctivæ stained; slight icteric tint not uncommon.

ALIMENTARY SYSTEM.—Tongue furred, appetite poor, breath often heavy.

EVACUATIONS.—Infrequent, insufficient, hard, and often scybulous; much straining; mucus common.

DIARRHŒA.—Attacks not uncommon, from irritation of scybala. Rarely in very severe constipation (dilatation of colon) mass of fæces may canalize, and diarrhœa, with small motions, result.

GENERAL SYMPTOMS.—Include: Lassitude, lack of concentration, mental depression, vertigo, headache, and sleeplessness (especially with full rectum).

ABDOMEN.—Either normal, retracted, or distended. Distension usually from gas. Large masses of fæces may be palpable. Characteristics of these: movable, and diminish after enemata, rarely pit on pressure; site, very rare above splenic flexure, extremely rare in cæcum.

RECTUM.—Usually contains hard fæces. May be empty.

PAIN.—Results from: (1) Irregular intestinal contractions; (2) Pressure on nerves: (a) Front of left thigh, from pressure on anterior crural nerve; (b) Back of thigh or hip-joint (twig from 3rd sacral), from rectum pressing on 3rd, 4th, or 5th sacral nerves.

Sequelæ, Complications, and Remote Effects.—These occur as a result of:—

1. **GENERAL ILL-HEALTH.**—Boils, acne, anæmia, etc.
2. **RISE OF INTRA-ABDOMINAL PRESSURE.**—Hernia, hæmorrhoids, apoplexy, palpitation. From straining.
3. **IRRITATION OF INTESTINAL MUCOUS MEMBRANE.**—Diverticulitis and perisigmoiditis.
4. **ACCUMULATION OF FÆCES.**—Dilatation of intestines, in ultimate form as Hirschsprung's disease. Possibly volvulus. Nocturnal emissions.

Numerous conditions have some association, e.g., gall-stones, muco-membranous colitis. Relation of appendicitis is doubtful. Rupture of gut while straining is exceedingly rare.

Diagnosis.—Self-diagnosis must not be accepted. Consider symptoms, signs, use of aperients, and effect of omission. Radiographs always valuable. Time in passage through intestine also found by giving charcoal and noting interval before appearance. Organic causes of constipation must be excluded.

Treatment.—

GENERAL PRINCIPLES.—(1) Daily motion to be attempted at regular hour. (2) Missing motion for one day is not reason for taking or increasing dose of aperient. (3) Aperients to be reduced to minimum. (4) Remedial abdominal exercises: massage alone of little value.

DIETETIC.—A sufficient mixed diet containing residue (cellulose) and salts. Excessive roughage inadvisable.

SPECIAL ARTICLES.—Porridge, wholemeal bread; fruit of most kinds, apples, prunes, figs, oranges; vegetables.

Constipation—Treatment, continued.

FLUIDS.—Glass of water half an hour before meals, especially breakfast. Fluid, $2\frac{1}{2}$ to 3 pints daily.

APERIENTS.—When unavoidable, small daily dose is best measure: not to be increased for missing occasional motion.

LIQUID PARAFFIN.—Keeps motions soft. May cause flatulence: occasionally seepage occurs.

AGAR-AGAR: Many good preparations. **SALTS:** In small daily doses. **SENNA:** Infusion of pods. **PSYLLIUM SEEDS.**

ENEMATA.—

GLYCERIN ENEMA (\mathfrak{z} j with equal volume of warm water).—Give when morning motion due; often valuable when omitting aperients; amount gradually reduced; harmless.

OLIVE OIL (\mathfrak{z} iv–vj).—In severe dyschezia; inject overnight; soap-and-water enema may be given in morning.

SOAP-AND-WATER ENEMA.—For acute or occasional constipation. Plombières douches and colonic washes should not be used for simple constipation.

XI. VISCEROPTOSIS.

(*Enteroptosis. Splanchnoptosis. Glénard's Disease.*)

A condition characterized by abnormal descent and mobility of the abdominal contents, accompanied either by irregular symptoms, often neurasthenic, or by none at all. Becoming rare.

Varieties.—Two groups occur:—

1. '**PENDULOUS BELLIES**'.—Condition follows repeated pregnancies, or ascites. May be no symptoms, or constipation and vague dyspepsia, but no ancillary neurasthenia. Abdominal belt and simple remedies usually sufficient. *Not further referred to in this section.*
2. '**VIRGINAL TYPE**'.—Occurs in younger persons, usually thin, with long chest and abdomen, thoracic breathing, low blood-pressure, and general 'hypotonic diathesis'. Commoner in women: but occurs also in men, sometimes with apparently good physique.

Pathogenesis.—The muscles of the abdominal wall and pelvic floor by their tone normally maintain the intra-abdominal pressure which holds the viscera in position. Weakness of these muscles, resulting in fall of the intra-abdominal pressure, is the essential factor in production of visceroptosis. Weakness and atony of visceral muscles also result in dilatation of viscera, and aid development of visceroptosis.

SUBSIDIARY FACTORS (often claimed as primary cause).—Include: (1) *Abnormal descent of diaphragm.* Diaphragm is low, in position of complete inspiration. (2) *Condition of suspensory ligaments.* These normally do not support the viscera but keep them in their relative positions; in visceroptosis, they are dragged

upon and produce discomfort. (3) Loss of fat often blamed, but many subjects have always been thin. (4) Erect posture of man and sedentary habits of women.

Cause of Symptoms.—Little understood. (1) Abdominal symptoms: due to disturbance of function; not accounted for by position of viscera. (2) Neurasthenic and vasomotor symptoms. Abdominal muscles form part of mechanism for maintaining blood-pressure constant with changes of posture. If mechanism deficient, blood stagnates in the splanchnic vessels and subjects "bleed into their own abdomen", especially when assuming erect posture from lying; hence symptoms of vasomotor disturbances. Immobility of diaphragm assists this stagnation and also produces dyspnœa. (3) Constipation is due to weakness of muscles and not to 'kinks' (see CONSTIPATION).

Symptoms.—May be grouped as:—

- a. NEURASTHENIA AND GENERAL DEBILITY.—Lassitude, pains in back and elsewhere. Exhaustion, lack of concentration.
- b. ABDOMINAL SYMPTOMS.—Abdominal discomfort and fullness. Dragging sensation, eased by lying down. Flatulence and flatus. Anorexia. Constipation.
- c. CIRCULATORY AND VASOMOTOR.—Faintness, flushing, palpitation, abdominal throbbing: especially on changes of posture. *Also dyspnœa.*

PHYSICAL SIGNS IN ABDOMEN.—Wall thin. Muscles lax. Divergence of recti common. Pulsation marked. Stomach splash still present 4 hours after meals. Abnormal mobility and low position of various viscera.

Special Organs.—*Note:* Undue attention must not be paid to the condition of separate organs.

GASTROPTOSIS.—See p. 424.

COLOPTOSIS.—Often present without symptoms. Prolapse of colon, especially transverse. Some descent of hepatic flexure, but little of splenic flexure. Redundant loops in descending colon.

RADIOGRAPHS.—Transverse colon often droops into pelvis. At splenic flexure a V-shaped loop appears in antero-lateral position, but more lateral position shows that no sharp kink is present.

NEPHROPTOSIS.—Usually present in visceroptosis. (See MOVABLE KIDNEY.)

DIAPHRAGM.—In position of maximum inspiration. Movements slight.

LIVER.—Displacement not so common. Owing to peritoneal attachments, liver tends to rotate, anterior inferior edge moving backwards and obscuring displacement. This rotation brings gall-bladder almost vertical instead of at an angle of 45°; traction of prolapsed duodenum further impedes passage of bile.

Visceroptosis—Special Organs, continued.

VARIOUS.—(1) *Pylorus* is freely movable and can easily descend. Second part of duodenum is less movable, but may descend to some extent. (2) *Pancreas* and root of mesentery may fall one to two inches. (3) Prolapse of pelvic viscera is very commonly present. (4) Descent of spleen is rarely sufficient to be palpable, but occasionally extreme. (5) *Heart* may descend.

Treatment.—The patient must be viewed as a whole, mentally and physically, and attention must not be riveted on a single organ. Indications are to treat the neurosis, to strengthen the abdominal muscles, and rest those overstrained. Sedatives—e.g., bromides, luminal—often indicated.

1. **REST.**—If neurasthenia is prominent, treat as such, with rest in bed and if necessary Weir-Mitchell treatment. In lesser grades, rest one hour after meals, especially lying on right side.
2. **MECHANICAL SUPPORT.**—Abdominal belt, affording pressure below the umbilicus; apply when lying down.
3. **EXERCISES.**—Of very great importance. Specially designed exercises to raise diaphragm and strengthen abdominal muscles.
4. **DIET.**—As in ATONIC STOMACH (see p. 425).
5. **CONSTIPATION.**—As in ATONIC STOMACH (see p. 426).

Surgical Treatment.—No operation should be performed in this group for fixing dropped viscera. Results of the simpler operations are bad, and of the severer operations often tragic. This type welcomes operations and drifts readily from one to another. Appendectomy is frequently performed on account of the vague dyspepsia and the possibility that the appendix is the cause: much less harm is done by leaving *in situ* an occasional chronic appendix than by starting these subjects on a career of operations.

XII. DILATATION OF THE COLON.

Occurs in four forms, depending on the cause:—

1. **GASEOUS (TYMPANITES).**—Common, rapid and temporary, painful. No obstruction necessary. Small intestine also usually affected. In acute abdominal and certain febrile conditions it may be extreme, affecting heart and lungs. (See TYMPANITES, p. 454.)
2. **FÆCAL CONCRETIONS.**—Common. Usually aged females, especially insane. Often stony consistency. Colon thin, no muscular hypertrophy. *Sequelæ*: chronic and acute obstruction, ulceration, perforation, colitis. Foreign bodies extremely rare in colon. (See CONSTIPATION and INTESTINAL OBSTRUCTION.)
3. **ORGANIC OBSTRUCTION.**—Usually carcinoma. Colon may almost fill abdomen: muscular hypertrophy (mainly circular fibres) and dilatation. *Sequelæ*: obstruction, ulceration, perforation, colitis. (See INTESTINAL OBSTRUCTION.)
4. **IDIOPATHIC DILATATION OF COLON (HIRSCHSPRUNG'S DISEASE).**—See p. 485.

HIRSCHSPRUNG'S DISEASE.*(Megalocolon.)*

Dilatation and hypertrophy of colon without organic obstruction.

Etiology.—(1) In children and adolescents—5 males to 1 female ;
(2) In adults.

Note.—Title 'Hirschsprung's disease' usually confined to children.

Morbid Anatomy.—Dilatation of part or whole of colon : often enormous, with twisted coils, may fill abdomen. *Site* : Descending and pelvic colon most affected ; often whole colon. Rectum in children often escapes or only slightly affected (but may dilate with enema). *Muscular hypertrophy* of circular and longitudinal layers. *Colonic contents of muddy consistency* with hard concretions. In chronic cases inflammation of colon. No evidence of obstruction. Small intestine collapsed.

Pathogenesis.—Uncertain. The two age-groups may be different.
Theories :—

1. **DISORDER OF NEURO-MUSCULAR MECHANISM**, controlling colon and rectum ; whence failure to relax when colon contracts. Generally accepted, but site of difficulty uncertain, viz. : (a) If at anal sphincter, rectum should dilate ; (b) No pelvi-rectal sphincter has been established ; (c) Disorder may be segmental in colon.
2. **CÆLIAC DISEASE.**—Cause of few younger cases.

Mode of Onset.—Constipation and abdominal distension may be noted from infancy, or childhood. In adults, symptoms may be slight.

Symptoms.—Characteristic :—

1. **CONSTIPATION.**
2. **PROGRESSIVE DISTENSION OF ABDOMEN.**
3. **PAIN.**—Attacks of pain, increasing with distension. Vomiting *not marked, often absent.* Due to partial obstruction.
4. **STOOLS.**—Soft, with few scybala.
5. **DIARRHŒA.**—Gives temporary relief, with reduction of abdomen.
6. **GENERAL CONDITION.**—Often good : may be thin. *Rarely* dyspnoea and palpitation from pressure on diaphragm.

Physical Signs.—

ABDOMEN.—Great enlargement : colon may be visible in left and upper abdomen ; during attacks of colic, may be visible coils and peristalsis.

DIAPHRAGM.—Left dome very high.

RECTUM.—May contain *stony concretion*, or scybala, or soft mass.

Diagnosis.—Usually simple : (1) Age ; (2) Constipation, and character of stools ; (3) Progressive distension. Radiographs with barium meal and enema confirm.

Progress and Prognosis.—Progresses, in absence of treatment, to acute obstruction or perforation, or to malnutrition. Children untreated rarely survive to adult life. With medical treatment, reasonable health obtained.

Hirschsprung's Disease, continued.**Treatment.—**

1. **MEDICAL.**—*Indication is to keep the colon empty.* If it is full, empty with enemata. When colon has been emptied: (i) Colonic wash daily; (ii) Massage to abdomen, and general treatment of chronic constipation; (iii) Liquid paraffin. Avoid all aperients.
It is necessary to maintain the treatment for a period of several years. *Cæliac disease must be remembered.*
2. **RESECTION OF COLON.**—High mortality. Other portions enlarge subsequently.
3. **OPERATIONS ON SYMPATHETIC NERVE-SUPPLY.**—The immediate results claimed to be good. Unnecessary in view of good results of medical treatment.

XIII. DIVERTICULITIS.

As a clinical term, this applies to pathological processes resulting from acquired false diverticula of the colon and rectum.

Etiology.—*Age:* middle age or later. *Males* commoner than females.

Morbid Anatomy.—Size of cavity small, up to a French bean; aperture often minute. Usually multiple, may be numerous. *Site:* Great majority in descending colon, especially sigmoid flexure; sometimes scattered throughout colon; occasionally localized in other sites, e.g., cæcum. Origin usually opposite the appendices epiploicæ, which they tend to enter. As lumen enlarges, apex curves backwards towards the attachment of the mesentery. When small, diverticulum is 'false', i.e., has all layers of intestine including muscular; on enlarging, it loses the muscular layer; mucous membrane usually atrophies.

Pathogenesis.—Chronic constipation is most important factor. Usually but not always stout subjects.

Diverticulosis.—Diverticula are often present without symptoms (shown by radiographs): *diverticulosis*. Symptoms result from inflammation of these: *diverticulitis*.

Symptomatology.—Very varied. Constipation increases. Blood in motions very rare. Diverticulum tends to enlarge, to contain faecal matter, and to undergo and to produce various secondary processes on which the symptoms depend. These secondary processes result from various grades of inflammation, and may be combined in various manners. The principal results are:—

1. **ACUTE DIVERTICULITIS AND INFLAMMATORY DISTURBANCES.**—Due to ulceration and perforation. Commonest type. *Symptoms:* Pain, tenderness, and rigidity in left lower quadrant, with or without a tumour. Bladder symptoms not uncommon. Closely resembles appendicitis, but on left side, and similarly may be acute, subacute, recurrent, or chronic. *Localized abscess formation* not uncommon, with fever and leucocytosis. Symptoms may be referred to pelvic organs,

especially in females, suggesting tubo-ovarian disease. Perforation may occur but is rare, owing to adhesions and tracking of diverticulum towards mesenteric attachment. Onset of acute symptoms may be sudden, and follow trauma, e.g., straining at stool, enema, sudden exertion. Other sequelæ below may develop subsequently.

2. **ADHESIONS TO VARIOUS STRUCTURES.**—Results may be: (i) Various vague pains and constipation; vesical and pelvic syndromes. (ii) *Fistulæ*, due to adhesions to organs and perforation; diverticulitis is commonest cause of vesicocolic fistulæ (commoner than cancer), and operation is often successful. (iii) Acute intestinal obstruction by bands or kinks. (iv) Local abscesses.
3. **PERIDIVERTICULAR FIBROUS HYPERPLASIA** (chronic diverticulitis).—From leakage of toxins or bacteria through walls. The fibrous tissue may be an inch or more in thickness; firm tumour forms; general results resemble cancer. Contraction of fibrous tissue stenoses the gut, producing *chronic obstruction*. Chronic proliferative peritonitis may develop, result resembling 'tuberculous cæcal tumour'.

Cancer may develop in the tumour, but no abnormal frequency.

Tumours are present in 30 per cent of all forms, and tend to vary in size from time to time.

Diagnosis.—Diverticulitis is a possibility in all patients over middle age with inflammatory troubles in left lower quadrant, in all cases suggesting carcinoma of colon, and in vesico-intestinal fistulæ; it must be excluded before deciding that the condition is inoperable. Radiographs are often decisive.

Diagnosis from Carcinoma.—(1) Absence of wasting and cachexia—patients usually stout; (2) Long history of abdominal pain in left lower quadrant; (3) Persistent absence of blood from stools; (4) Radiographs; (5) Sigmoidoscopy negative; (6) Pyrexia and leucocytosis may be present.

Treatment.—

MEDICAL TREATMENT.—Bed in inflammatory stages. Indication is to keep colon empty. Warm olive oil enema, 4 to 6 ounces, in acute stage. Colonic washes: daily at onset, later twice weekly regularly. Liquid paraffin: no aperients.

DIET.—Ordinary mixed.

SURGICAL TREATMENT.—For complications.

XIV. CARCINOMA OF THE COLON.

Etiology.—

AGE.—Usually over 40 years. Rectal neoplasms more variable.

SEXES.—About equal.

Morbid Anatomy.—Columnar-cell carcinoma: in proximal colon, often 'cauliflower' type, fungating early; in distal colon, annular growths causing obstruction.

Carcinoma of the Colon—Morbidity Anatomy, continued.

METASTASES.—Not common until late stages, except from rectum.

SITE.—Pelvi-rectal flexure and rectum: 55 per cent. Splenic flexure: 15 per cent. Transverse colon: 8 per cent. Hepatic flexure: 10 per cent. Cæcum: 12 per cent.

Mode of Production of Symptoms.—Due to:—

1. Effect of foreign body in wall. Causes increased peristalsis, resulting in diarrhoea.
2. Effect of fungating mass. Mucus, blood, and septic matter from surface of ulcer.
3. Effect of constriction. Obstruction causing: colicky pain, constipation, secretion from retained fæces. Later: visible peristalsis.

Note.—The resulting symptoms vary according to site of growth.

Initial and General Symptoms.—Often vague, attracting little attention. Discomfort in lower abdomen: pain rarely prominent. Loss of weight (often unobserved). Appetite usually diminished; may be good even with loss of weight. Anæmia usual. Cachexia slight.

CHARACTERISTIC MANIFESTATION.—Change in habit of bowels. May be: (1) Increasing constipation; (2) Increasing looseness, i.e., aperients no longer necessary, progressing to diarrhoea, true or spurious; (3) Alternate constipation and diarrhoea.

Cæcum.—Usually cauliflower growth: constipation and obstruction rare. Symptoms:—

1. Tumour palpable: in 70 per cent.
2. Diarrhoea common: not usually alternating with constipation. Motions not characteristic.
3. Discomfort at site. Loss of weight and anæmia may be marked.

Hepatic Flexure.—As cæcum. Stools may contain obvious blood.

Transverse Colon.—Growth may be cauliflower or annular. If obstruction, pain may be on right side and cæcum distended. Diarrhoea or constipation. Tumour may be palpable.

Splenic Flexure.—Obstruction early. Tumour not palpable. Pain local and also on right side if cæcum distended. Alternating constipation and diarrhoea.

Pelvi-rectal Flexure.—Symptoms:—

1. Obstruction early: from annular growth and retained fæces. Colic, colonic distension.
2. Bowels: (a) Increasing constipation: 60 per cent. (b) Diarrhoea, either true or spurious—viz., frequent call with passage of mucus, blood, secretion from growth or retained fæces or flatus only: often in early morning. May alternate with constipation. Gross hæmorrhage unusual.

3. Tumour: Palpable in 25 per cent (often due to faecal retention). Often impalpable by rectum in early stages.
4. Discomfort in left side.
5. Rectum usually ballooned.

Diagnosis.—From colitis, diverticulitis, polyposis. On right side, from appendicitis, ileitis, tuberculosis, actinomycosis.

RADIOGRAPHS.—Barium enema usually diagnostic.

SIGMOIDOSCOPY.—In doubtful cases.

Treatment.—Operative. Comparative rarity of metastases and glandular involvement give relatively favourable prognosis.

XV. REGIONAL ILEITIS.

(*Crohn's Disease.*)

A localized chronic inflammatory lesion of the ileum of unknown origin progressing to fibrosis.

Etiology.—*Age*: 4 to 40 years: mainly young adult males.

Morbid Anatomy.—*Site*: Terminal ileum most commonly affected, usually few inches; extends to cæcum, maximum at ileocaecal valve. All coats of ileum involved, is thick, cedematous, and rigid; mucous membrane inflamed and ulcerated. Progresses to: (a) fibrosis, causing obstruction; (b) adhesion of coils, with fistulae (may open on surface); (c) mesentery thickened; (d) lymphatic glands enlarged. Never becomes malignant. *Microscopic*: Chronic inflammation, giant cells; no tubercle bacilli.

Symptoms.—Due to ulceration and obstruction.

GENERAL.—Loss of weight. Anæmia. Anorexia. May be polynucleosis.

ABDOMINAL.—Progressive attacks of colicky pain in right lower quadrant. Diarrhoea and vomiting may occur; constipation between attacks. *Tumour*: Sausage-shaped in right iliac fossa. *Abdomen*: Central distension. *Stools*: Occult blood.

RADIOGRAPHS.—(1) Small intestine: distended loops. (2) Filling defect, proximal to cæcum. (3) 'String sign': narrow shadow through filling defect. Enema: may run through into ileum.

Diagnosis.—From appendicitis, carcinoma, ileocaecal tuberculosis, actinomycosis.

Treatment.—Excision of affected intestine. Prognosis good.

XVI. POLYPOSIS OF THE COLON.

Polyposis of the colon may be: (1) Solitary polyp: common. (2) Generalized polyposis, rare: (a) Congenital (and may be familial): innumerable polypoid adenomata, in children and adolescents. (b) Chronic ulcerative colitis. (3) Bilharzia and rarely other parasitic infections.

Polyposis of the Colon, *continued*.

Symptoms.—

1. DIARRHŒA.—Either from irregular peristalsis or result of secondary infection.
2. RECTAL HÆMORRHAGE.—Bright red blood.
Either of above may be sole symptom.

Sequelæ.—

1. Anæmia and malnutrition. Infantilism may develop.
2. Intussusception.
3. Neoplasm. Frequent in generalized type.

Diagnosis.—By rectal examination and sigmoidoscopy.

RADIOGRAPHS.—Rounded semi-translucent areas.

Treatment.—Destroy by cautery or remove affected intestine.

XVII. LESIONS OF MECKEL'S DIVERTICULUM.

Meckel's diverticulum present in 2 to 3 per cent of population : males higher. Following lesions may occur.

Peptic Ulceration.—Mucous membrane of distal portion may consist of ectopic epithelium resembling fundus of stomach with oxyntic cells secreting gastric juice. Ulceration is in basal part, lined with intestinal mucosa. *Usually no pain or symptoms.*
Manifestations:—

1. HÆMORRHAGE.—Sudden and severe. Rectal hæmorrhage may be bright, usually melæna.
2. PERFORATION.

Acute Intestinal Obstruction.—Diverticulum may be adherent to any site and cause obstruction. In infancy or early childhood.

Intussusception.—Subacute or chronic ; vomiting severe ; rectal hæmorrhage moderate. From infancy to adult life.

Acute Diverticulitis.—Resembles appendicitis, but more central.

XVIII. CÆLIAC DISEASE AND IDIOPATHIC STEATORRHŒA.

A condition associated with deficient absorption of fat from the intestines, resulting in sequelæ from defective metabolism of fat, calcium, and vitamins, and in passage of stools containing excess of fat.

Note.—Knowledge of this group has extended rapidly recently, including recognition of :—

1. Occurrence of (a) mild forms and (b) adult cases.
2. Interference with calcium metabolism. Probably due to lack of absorption of vitamin D. Results in the various effects of calcium deficiency : (i) *Defects of bone formation*—rickets, osteomalacia ; (ii) *Tetany*.

3. Interference with factors governing blood formation, resulting in anæmia of various types. Metabolism of vitamin B₂ possibly involved in some circumstances.

Many questions are still unsettled.

Synonyms.—Gee's coeliac affection. Coeliac, pancreatic, or intestinal infantilism or rickets. Idiopathic steatorrhœa of adults. Non-tropical sprue.

Classification.—Provisional description here adopted: (1) Coeliac disease in children; (2) Idiopathic steatorrhœa in adults.

1. CœLIAC DISEASE IN CHILDREN.

Etiology.—

AGE.—Onset usually can be traced to early childhood, between 1 and 5 years, or infancy: but often unrecognized until 5 to 7 years. Difficulty in digesting milk often noted from earliest infancy.

CLIMATE.—In all climates. Rare in Latin races.

SEXES.—Equal.

HEREDITY.—Considerable influence: not fully investigated. Syphilis is not a factor.

Pathogenesis.—No characteristic pathological changes, other than those attributable to complications. Cause of difficulty in fat absorption unknown. Of factors connected with fat metabolism in intestine, there is no evidence of:—

1. **PANCREATIC DEFICIENCY.**—Against: (a) No defect in fat-splitting; (b) No true steatorrhœa—i.e., passage of liquid separated fat; (c) No definite azotorrhœa; (d) No changes in pancreas at autopsy.

2. **DEFECTIVE BILE SECRETION.**

No evidence of endocrine deficiency.

RELATION TO SPRUE.—See IDIOPATHIC STEATORRHœA OF ADULTS, p. 494.

Symptomatology.—

GENERAL APPEARANCE OF CHILD.—Thin. Anorexia. Emaciation of body in severe types; face less affected. Muscular weakness. Development retarded; mentality slow but not stupid.

INFANTILISM and lack of sexual development: in older children, with severe disease.

SYMPTOMS.—Referred to three groups:—

1. **GASTRO-INTESTINAL MANIFESTATIONS.**—The characteristic feature. Due to essential error of fat absorption.

Stools.—Loose, pale, and copious. Number varies: may not exceed two or one daily. In severe cases, frothy and offensive: bulkiness in these often extreme. Exacerbations at irregular intervals. Aggravation with any increase of fat in diet.

Cœliac Disease in Children—Symptomatology, continued.

Abdomen.—Distended: mainly from flatulence. Muscles lax: liver may be palpable (prolapse rather than enlargement).

Megacolon.—May develop, especially in cases *without* frequent stools.

Appetite poor. *Vomiting* if over-dieted.

Note.—Many of these children dislike fat and milk foods; consumption often forced by parents.

2. **INTERFERENCE WITH CALCIUM AND PHOSPHORUS METABOLISM.**—Exhibited only in severe cases.

a. Defective bone development.—Osteoporosis. *Rickets* (not distinguishable from ordinary rickets).

b. Tetany.—Common in rickety cases but rare otherwise.

3. **ANÆMIA.**—See IDIOPATHIC STEATORRŒHA OF ADULTS.

VARIOUS FEATURES.—

BLOOD-SUGAR CURVE.—Low flat curve.

BASAL METABOLIC RATE.—Low.

RADIOGRAPHS.—Diminished density of bone.

GASTRIC JUICE.—Free HCl may be normal, low, or absent.

CHARACTERS OF FÆCES.—

1. **FAT.**—

a. Forms over 50 per cent (may be 70 or 80) of dried fæces in acute stages. In quiescent periods moderately or slightly increased: rises on fat or milk diet.

b. Is mainly split, viz., fatty acids and soaps (salts of fatty acids): may be 80 per cent of total fat.

2. Bulkiness and frothiness is due to carbohydrate fermentation.

3. Consistency and colour of stools varies with (*a*) amount and (*b*) nature of fat.

CALCIUM AND PHOSPHORUS DISTURBANCES.—

CAUSE.—Mainly due to deficient absorption of vitamin D from same cause as fat defect. Other factors: low fat diets are poor in calcium; formation of unabsorbable calcium soaps from excessive intestinal calcium.

Manifestations are due to hypocalcæmia. Occurs in only small proportion of cœliac disease, but is common in severe grades.

(See CALCIUM AND PHOSPHORUS METABOLISM.)

Course and Prognosis.—Condition is constitutional and long-continued. Course and variations of great importance.

EXACERBATIONS.—Characteristic feature. Recurrent attacks of pyrexia, general malaise, and intestinal disturbance. Attacks of all degrees of severity and various durations. Diet at such periods necessarily restricted, and usually little fat: hence gradual improvement occurs. Often followed by administration of rich fat and milk diet by parents anxious for child to regain lost weight, and thus in time recurrence of attack.

REMISSIONS.—Stools may appear normal, health fair, gradual gain in weight.

PERMANENT IMPROVEMENTS.—Power to absorb fat may increase: abdominal disturbances diminish and growth develops. In others, on entering puberty and dietary independence, fats are automatically avoided: many subjects recognize inability to take fat throughout life. Megacolon may persist.

FATAL COURSE.—From extreme wasting and exhaustion, or from tetany (high mortality).

MILD AND PARTIAL FORMS.—Not uncommon: often overlooked. Recurrent irregular attacks of pyrexia and abdominal discomfort. In intervals, stools practically normal and health fair. Some thin, others plump. Mentally often slow, and power of concentration impaired, but not stupid. Other manifestations slight or absent. On reaching puberty and suitable diet, may develop rapidly intellectually. Often precocious and 'difficult': during attacks, listless and power of concentration impaired.

PERSISTENCE INTO ADULT LIFE.—Many milder cases pass into adult life: condition may become recognized, with or without aggravation, as **IDIOPATHIC STEATORRHOEA OF ADULTS** (q.v.).

Diagnosis.—Mainly from various fatty diarrhoeas. From colitis by examination of stools.

1. **CONGENITAL STEATORRHOEA.**—Fæces: large, formed, well-coloured, not frequent, not offensive: occasionally, fat solidifies 'like butter': fat mainly as soaps. Formerly described as an 'inborn error of metabolism' distinct from coeliac disease, but many cases probably identical of mild type. Subject needs new study.
2. **ORGANIC ABDOMINAL DISEASE.**—Fatty diarrhoea, anæmia, and glossitis may develop in certain lesions, e.g., (a) Chronic pancreatitis and destruction of pancreas by neoplasm or calculi; (b) Gastro-colic fistula, and extensive resections of intestine; also (c) Tuberculous obstruction of lacteals.
3. **SPRUE.**
4. **MEGACOLON AND HIRSCHSPRUNG'S DISEASE.**—Some, not all, are secondary to coeliac disease.

Treatment.—

GENERAL PRINCIPLES.—

1. **LOW-FAT DIET.**
2. **SUPPLY OF VITAMIN D.**—As irradiated ergosterol (not fish-liver oil); or ultra-violet light. Also vitamins A, B, and C.
3. **IF ANÆMIA.**—Iron and yeast.
4. **CONTROL STARCH.**—If evidence of carbohydrate fermentation.
5. **TETANY AND RICKETS.**—See TETANY and RICKETS.

LOW-FAT DIET.—

No milk, cream, butter, cheese, or bacon. No pastry or fried food. Fat in all forms to be reduced to minimum.

Skimmed milk: 2 pints daily. (Calcium lactate as alternative.) To be taken plentifully: Sugar, orange juice, green vegetables, fluids.

To be taken as desired: Bread, meat, fish (boiled), eggs, jam.

Note.—Anæmia and tetany need separate treatment.

Cœliac Disease and Idiopathic Steatorrhœa, *continued*.

2. IDIOPATHIC STEATORRHŒA OF ADULTS.

Recognition of comparative frequency of this condition is recent, and further study is necessary, both of mild and severe grades.

Relation to Associated Conditions.—

1. CŒLIAC DISEASE.—On careful inquiry, *most cases* of adult steatorrhœa can be traced to childhood, and are identical with cœliac disease.
2. SPRUE.—General manifestations closely similar: some common link, but identity unproved.
NOTE.—In sprue: (a) Onset in childhood is rare; (b) Low blood calcium is rare.
Sprue is not included in this section.
Non-tropical Sprue is a synonym for steatorrhœa of adults.
3. TUBERCULOUS OBSTRUCTION TO THE LACTEALS.—Rare cause of true adult cases.

Morbid Anatomy.—No pathognomonic or constant changes apart from complications.

CENTRAL NERVOUS SYSTEM.—Evidence of combined degeneration uncertain.

COLON.—May be dilated.

Symptomatology.—

GENERAL MANIFESTATIONS.—Closely similar to cœliac disease, of moderate or mild severity, modified by age and affected by long duration.

IRREGULAR ATTACKS OF PYREXIA and abdominal disturbance.
INFANTILISM in severe grades.

SYMPTOMS.—Mainly referred to three groups:—

1. GASTRO-INTESTINAL MANIFESTATIONS.—

Stools.—Diarrhœa in adult life uncommon, but usually recorded in youth or infancy. Fæces may be normal in number and appearance. Fat: (a) Total fat, 50 per cent or over of dried fæces; (b) Mainly split, especially as soaps. Changes rarely so extreme as in children. Influenced by fat-rich diet.

Abdomen.—Distension variable. Megacolon common (especially without diarrhœa).

Tongue.—May be smooth from atrophy of papillæ. Rarely sore. No relation to achlorhydria.

2. INTERFERENCE WITH CALCIUM AND PHOSPHORUS METABOLISM.—Marked in severe cases but not in others.

a. **Bones.**—Pains in bones. Kypho-scoliosis. Joint deformities, e.g., genu valgum. Fractures. Osteoporosis.

b. **Tetany.**—Latent and active.

c. Clubbing of fingers, opacities in lens (slit-lamp), skin lesions.

3. ANÆMIA: INTERFERENCE WITH BLOOD FORMATION.—(See p. 495.) Anæmia is not always present.

Sprue—Pathology, continued.

intestine usually severely affected, but no portion immune, and mouth is early and constantly involved. Liver and spleen smaller than normal. Mesenteric glands enlarged. Colon may be dilated. Bone-marrow often atrophic.

Symptoms.—

ONSET.—Gradual or sudden : often previous dysentery or diarrhoea. Stomatitis constant : may be long period before diarrhoea occurs. Remissions and recurrences usual : duration frequently years. Entire alimentary tract finally affected.

CHARACTERISTIC SYMPTOMS.—

1. **STOMATITIS.**—Tongue, mouth, and fauces painful : catarrh and ulceration of mucous membrane. Subsequent atrophy and smooth areas on tongue.
2. **FATTY DIARRHŒA.**—Stools gray or white, loose, bulky, and frothy. *Fat in large amounts.* Bile pigment is present, but bilirubin is reduced to a colourless substance. Fat as in **CŒLIAC DISEASE** (q.v.), but soaps scanty.
3. **WASTING.**—Skin dry and dark. Liver and spleen small. Extremities cold.
4. **ANÆMIA.**—Microcytic, megalocytic, or combinations (as in **CŒLIAC DISEASE**).—May be no anæmia. Never subacute combined degeneration.
5. **TETANY.**—Rare : less common than in celiac disease, as blood calcium not usually low. *Osteoporosis* common.

VARIOUS OTHER SYMPTOMS.—

DYSPEPSIA AND FLATULENCE.

ABDOMINAL DISTENSION. MEGACOLON.

GASTRIC ACIDITY. LOW BLOOD-SUGAR CURVE. CALCIUM METABOLISM ANOMALOUS (*see CŒLIAC DISEASE*).

Prognosis.—Poor after middle age. Younger subjects may recover : should never return to Tropics.

Treatment.—Fatty diarrhoea, anæmia, and tetany need separate treatment. General principles :—

1. **AS IN CŒLIAC DISEASE.**
2. **BLOOD TRANSFUSION.**—Benefit often marked and may be lasting.
3. **MILK AND STRAWBERRIES.**—Commence milk with 2 to 3 pints, increasing to 5 pints : after at least 4 weeks gradually increase diet, avoiding carbohydrates. Strawberries : commence with a few at each feed, increase to several pounds daily, and continue as long as obtainable. Other fruit less effective. If milk not well tolerated, meat-juice may be given 1 or 2 days a week.

Treatment is prolonged, but, if obtainable as above, usually successful ; much atrophy of mucous membranes of alimentary tract is permanent after long attacks and recurrences, and subsequent care is necessary.

XX. MISCELLANEOUS CONDITIONS.**DIPHTHEROID ENTERITIS.***(Croupous Enteritis. Secondary Membranous Enteritis.)*

Rare. Of pathological interest only. Not caused by Klebs-Loeffler bacillus.

OCCURRENCE.—

1. SEVERE ACUTE INFECTIONS.—Septicæmia, pneumonia, enteric.
 2. TERMINAL.—In chronic wasting diseases: cancer, nephritis, cirrhosis of liver.
 3. INORGANIC POISONS.—Arsenic, mercury, lead (acute).
- SYMPTOMS.**—Nothing characteristic. Diarrhœa, if from poisons, severe; in other cases slighter.

PHLEGMONOUS ENTERITIS.

Similar to, but even rarer than, phlegmonous gastritis.

VARIETIES.—

1. PRIMARY.—Duodenum commonest.
2. SECONDARY.—From intestinal obstruction.

SYMPTOMS.—As in peritonitis, or intestinal obstruction.

DIAGNOSIS.—Only at operation or autopsy.

INTESTINAL SAND.

OCCURRENCE.—In two forms: (1) False; (2) True.

1. FALSE.—Residue after eating certain fruit, especially pears. No importance. Also in hæmophilia.
2. TRUE.—Chiefly seen in mucomembranous colitis. Consists of: (1) Organic matter, 30 per cent; (2) Inorganic matter, 70 per cent. Mainly calcium phosphate. No cholesterol. Mode of formation unknown.

AFFECTIONS OF THE MESENTERY.

1. **Hæmorrhage.**—Occurs in: (a) Aneurysm: abdominal aorta, superior mesenteric artery. (b) Malignant type of specific fevers, e.g., small-pox. (c) Idiopathic. Also in hæmophilia. Associated with hæmorrhage into retroperitoneal tissues and pancreas.

SYMPTOMS.—Acute intestinal obstruction.

2. **Embolism and Thrombosis.**—Embolism occurs in arteries, from mitral stenosis or infective endocarditis. Thrombosis in veins: (a) Secondary to sepsis in appendicitis, pyelophlebitis, etc.; (b) Primary in cirrhosis of liver, syphilis, cachectic conditions.

RESULT.—Infarction of mesentery, terminating in gangrene of intestine supplied, or perforation and peritonitis. In the case of the superior mesenteric artery, always fatal.

Affections of the Mesentery—Embolism and Thrombosis, *continued*.

SYMPTOMS.—'Paralytic ileus' (*see* p. 477).

ACUTE.—Symptoms of acute obstruction; may be stools with blood; hæmatemesis common.

CHRONIC.—May be no abdominal symptoms.

DIAGNOSIS.—Possible only with endocarditis.

TREATMENT.—Operative. Survival rare.

3. Disease of the Mesenteric Veins.—Suppuration common in pylephlebitis.

4. Disorders of Chyle Vessels.—

CHYLOUS ASCITES.—*See* ASCITES, p. 557.

CHYLOUS CYSTS.—*See* NEW GROWTHS IN THE PERITONEUM, p. 555.

CHYLANGIOMATA.—Occur in small intestine.

5. Cysts of the Mesentery.—*See* NEW GROWTHS IN THE PERITONEUM, p. 555.

CHAPTER LXXXIV.

DISEASES OF THE LIVER.

I. JAUNDICE.

(*Icterus*.)

A condition characterized clinically by staining of the skin, mucous membranes, and tissues by bile pigment, and usually by its presence in the body fluids. Jaundice is a symptom and not a disease. Three principal groups recognized: (1) *Obstructive*; (2) *Toxic and Infective*; (3) *Hæmolytic*, corresponding roughly to causes originally operating beyond, in, and before the liver respectively.

Much research has been performed in recent years on the production of jaundice and its occurrence in clinical conditions. Many conclusions have been based on unsatisfactory animal experiments. Most of the problems are unsettled, but the present position is indicated provisionally in the following paragraphs.

Histological Structure of the Hepatic Lobule.—

1. The bile capillaries commence in a blind end, like a test-tube, near the central hepatic vein, and run outwards to the bile-ducts.
2. Portal capillaries run through the lobule, along and outside the bile capillaries, from the branches of the portal vein outside to the hepatic vein in the centre.
3. A layer of polygonal liver cells lies between the portal capillaries and the bile capillaries.

4. Large endothelial cells, so-called Kupffer cells, lie scattered on the walls of the portal capillaries.

KUPFFER CELLS.—Possess certain staining reactions in common with various other endothelial cells (the 'reticulo-endothelial' system) with specialized functions in different parts of the body—e.g., endothelial cells of spleen, bone-marrow, and lymphatic glands; interstitial cells of testis; reticular cells of thymus; capillary endothelium of suprarenals.

Formation and Secretion of Bilirubin by the Liver.—Two types of specialized cells present: (a) Kupffer's; (b) Polygonal liver cells. Theory of action: (1) Kupffer cells break down hæmoglobin and form bilirubin; (2) Polygonal liver cells have not this function, but pass the bilirubin through to the bile capillaries, some change in composition occurring in the passage, thus accounting for two varieties of bilirubin.

Formation of Bilirubin outside the Liver.—Now accepted that bilirubin can be formed by all reticulo-endothelial cells—e.g., in bone-marrow.

Destruction of Red Cells and Liberation of Hæmoglobin.—By all reticulo-endothelial cells, but normally predominantly in spleen.

Pathological Aspects of the Types of Jaundice.—

1. **OBSTRUCTIVE JAUNDICE.**—Origin not in doubt.

- a. Bile pigment, formed in normal manner and passed into bile capillaries and ducts, is there obstructed and finally reaches the blood.
- b. Bile pigment reaches blood mainly by absorption from bile capillaries. Some capillaries may dilate and rupture into lymphatics and bile reach blood through thoracic duct.
- c. Van den Bergh's reaction (see p. 501): Immediate direct positive reaction (as with bile from gall-bladder) when obstruction complete.

NOTE.—Bile secreted is probably no longer normal after obstruction has persisted for a short period.

2. **TOXIC AND INFECTIVE JAUNDICE.**—Two alternative theories of origin:—

- a. *Cholangitis, inflammation and swelling of smallest bile capillaries, producing obstruction. Blockage aided by 'biliary thrombi'.* (Naunyn, 1919.)
- b. *Changes in hepatic cells disturbing secretion of bile.*

Evidence in regard to these:—

- i. No cholangitis is present in epidemic jaundice, in various forms of toxic jaundice (e.g., phosphorus, post-anæsthetic), or in jaundice of alcoholic or Hanot's cirrhosis.
- ii. Changes of all grades in hepatic cells can be found histologically, e.g., in catarrhal jaundice, in salvarsan hepatitis.

Jaundice—Pathological Aspects, *continued*.

iii. Occurrence of 'dissociated jaundice': bile salts sometimes excreted normally, while bilirubin is retained.

iv. Van den Bergh's reaction: Results inconstant, may vary rapidly; biphasic reaction common.

CONCLUSION.—Damage to liver cells undoubted, and this group is a *hepatitis*. Probably also *cholangitis* often present. Proportional importance of the two changes may vary rapidly. Increased hæmolysis often an additional factor. Van den Bergh's test explained thus: Some bile fails to pass injured polygonal liver cells and is absorbed into blood unaltered, producing *delayed direct* reaction; at the same time some bile passes through and is changed by polygonal cells, enters bile capillaries, is blocked by *cholangitis* and absorbed into blood, producing *immediate direct* reaction; the sum of the two reactions is the *biphasic* reaction.

3. HÆMOLYTIC JAUNDICE.—Increased hæmolysis, mainly by spleen, followed by increased formation of bilirubin, is undoubted. On production of jaundice:—

i. Van den Bergh's reaction: Always delayed or negative direct reaction (indirect positive).

ii. Bile pigment usually absent from the urine.

iii. 'Renal threshold' for bile is much higher than in obstructive jaundice: urine being bile-free with considerable amounts in serum. Probably bilirubin escapes mainly as urobilin, which is always increased.

iv. Bile pigment usually present in fæces.

v. Amount of bile pigment in serum is not very large (but above threshold of obstructive jaundice).

vi. No *cholangitis* present.

DEDUCTIONS.—

a. Some bile pigment escapes by normal path (No. iv.).

b. Bile pigment present in serum differs from normal bilirubin of gall-bladder and of obstructive jaundice (Nos. i, ii, iii): this negatives obvious suggestion that bile is absorbed after normal secretion owing to its large amount raising pressure in bile capillaries.

THEORY.—Bilirubin formed by Kupffer cells partly passes directly into hepatic vein, not entering bile capillaries sufficiently rapidly. French authorities consider that definite *hepatitis* is present.

Note.—In pernicious anæmia, jaundice is due to difficulties in blood formation and not to destruction.

Catarrhal Jaundice.—Note, in regard to cause:—

1. Lævulose test (*see* p. 502): Evidence of impaired liver function for about three days (Spence and Brett).

2. 'Dissociated jaundice': Bile pigments may return to the bile before bile salts, or vice versa.

3. Van den Bergh's reaction: Very variable at different stages.

Evidence supports view, long held by French authorities, that *degeneration of liver cells*, i.e., hepatitis, is present and is principal factor. Cholangitis is also present; may be descending, certainly no proof of ascending from duodenum. The French deny that cholangitis produces any serious obstruction, but consider it may lead to hepatitis.

Van den Bergh's Reaction.—A very sensitive test for bilirubin by use of Ehrlich's diazo reagent, which is also effective for its presence in blood serum. Further, the test reacts differently in different forms of jaundice—the extreme types being complete obstructive jaundice and acholuric hæmolytic jaundice—owing probably to slight differences in the bilirubin. When jaundice is due to conditions in the liver and small bile-ducts, either or both types of bilirubin may be present: thus the test gives no assistance.

TECHNIQUE.—

REAGENT.—Two solutions which keep well:—

<i>A</i> Sulphanilic acid ..	..	1 gm.
Concentrated HCl..	..	15 c.c.
Distilled water ..	..	1000 c.c.
<i>B</i> Sodium nitrite ..	..	0.5 gm.
Distilled water ..	..	100 c.c.

These solutions are mixed in the proportion 25 c.c. of solution

A to 0.75 c.c. of solution *B* immediately previous to use.

BLOOD.—Remove 10 c.c. of blood from vein, allow to clot in small test-tube, and pipette off separated serum. Or run blood into oxalated tube, centrifuge, pipette off supernatant plasma.

PERFORMANCE OF TEST.—

1. **DIRECT REACTION.**—Add 1 c.c. of reagent to 1 c.c. of serum or plasma in a small test-tube. If test is positive, the result may be:—

1. *Immediate Direct Reaction.*—A bluish-violet colour develops and is at maximum in 10 to 30 seconds.
2. *Delayed Direct Reaction.*—A reddish colour develops in 1 to 15 minutes: gradually deepens to violet.
3. *Biphasic Direct Reaction.*—A reddish colour appears immediately, gradually deepening to violet.

2. **INDIRECT REACTION.**—Always positive if bilirubin present (to 1 in 1,000,000). Very sensitive, and hence always positive if direct positive. To 1 c.c. serum or plasma add 2 c.c. of 96 per cent alcohol; centrifuge; pipette off 1 c.c. of supernatant fluid, and add to it 0.5 c.c. of alcohol and 0.25 c.c. of reagent. If test is positive, a violet-red colour develops and is maximum instantly.

QUANTITATIVE ESTIMATION.—Measured by colorimetric test against standard solution. Bilirubin 1 in 200,000 equals one unit. In normal blood, bilirubin present (1 in 400,000 to 1 in 1,000,000) equals 0.5 to 0.2 unit. In bile from gall-bladder, bilirubin (1 in 3000 to 1 in 4000) equals 60 to 50 units.

Jaundice—Van den Bergh's Reaction, *continued*.

INTERPRETATION OF RESULTS.—

IMMEDIATE DIRECT REACTION.—Occurs in obstructive jaundice: may be 50 units (as in bile).

DELAYED DIRECT REACTION.—Occurs in hæmolytic jaundice, e.g., acholuric jaundice, pernicious anæmia. Direct reaction may also be negative (indirect positive). Amount not very high: rarely exceeds 10 units.

BIPHASIC REACTION.—Occurs in toxic and infective jaundice, including catarrhal jaundice. Thus useless in differential diagnosis between such conditions.

Renal Threshold for Bilirubin.—(a) In obstructive jaundice, 1 in 50,000 (4 units): lower dilutions result in 'latent jaundice'. (b) In hæmolytic jaundice, threshold is far higher; may be none in urine with 1 in 20,000 (10 units) in serum; probably different bilirubin; it is suggested that this only passes kidney as urobilin.

Latent Jaundice.—Retention of bile pigment in blood serum, insufficient to colour skin and not passing into urine. Is shown by van den Bergh's reaction. May occur in: (1) Cirrhosis of liver and some growths of liver—prompt direct reaction; (2) Pernicious anæmia—indirect or delayed direct reaction; (3) New-born infants always.

Gall-stones without Jaundice.—Bilirubin normal.

Icteric Index.—Serum or plasma, diluted with saline if necessary, is matched against arbitrary standard solution of potassium dichromate. Normal blood: 4 to 6 units. Latent jaundice: 5 to 15 units. Jaundice visible above 15 units. Index is useful as measure of progress in jaundice.

Lævulose Test for Hepatic Efficiency.—Ingestion of lævulose, 30 to 50 gm., has no effect on blood-sugar in normal persons. With liver insufficiency a rise occurs resembling normal 'blood-sugar curve' after glucose; the height and duration of rise is roughly proportionate to degree of insufficiency (Spence and Brett). The test, when positive, is reliable and valuable.

GENERAL SYMPTOMS OF JAUNDICE.

Result from: (a) Presence of bile in blood; (b) Absence of bile from intestine; (c) Hepatic toxæmia from disturbed function; and (d) Causal condition.

ICTERUS.—Affects all tissues except central nervous system. Earliest in conjunctivæ. Persists often one or more weeks after absence of bile from urine. (Often overlooked at night.) Colour: light yellow to—in *chronic* forms—green bronze.

BILE PIGMENTS IN URINE AND OTHER SECRETIONS.—*Urine*: greenish tint, may precede icterus; usually contains albumin, and *bile-stained hyaline casts*. Milk, saliva, and sputum uncoloured (except last if pneumonia present).

'CLAY-COLOURED STOOLS'.—Often large and offensive. *Colour* due to : (a) Absence of bile pigment (i.e., stercobilin) ; (b) Excess of fat. *Odour* due to higher fatty acids. Excessive fermentation, formerly ascribed to absence of the supposed antiseptic action of bile, usually not present.

CONSTIPATION.—Bile aids intestinal peristalsis. Diarrhoea if much fermentation. Anorexia, furred tongue, and gastric disturbance rarely absent.

ITCHING.—Often severe in chronic conditions.

OTHER SKIN CONDITIONS, such as sweating, urticaria, boils ; occasionally hæmorrhages ; rarely xanthelasma.

NERVOUS SYSTEM.—Depression and irritability are marked ; occasionally melancholia.

Other noticeable symptoms :—

SLOW PULSE.—In early stages only ; not extreme ; often absent.

BLOOD.—Serum bile-tinged (recognition simple). Coagulation time prolonged.

HÆMORRHAGES.—In severe and chronic cases, tendency to hæmorrhages, e.g., at operations : also telangiectases, purpura.

XANTHOPSIA, OR YELLOW VISION.

XANTHELASMA.—Rare. Yellowish plaques or areas : commonest on eyelids, very rarely diffusely on body.

Notes.—

LIVER, GALL-BLADDER, AND SPLEEN.—The question of enlargement depends on the cause of the jaundice.

FAT IN FÆCES IN JAUNDICE.—Mainly as *fatty acids*, unless pancreatic secretion is also absent (*see* p. 539).

ERYTHROCYTES in jaundice are abnormally resistant to hæmolysis (except in acholuric family jaundice), measured by action of hypotonic salt solutions : possibly compensatory to bile salts, which are strongly hæmolytic *in vitro*.

BILE SALTS.—Present in blood only in early stages. Slow pulse is ascribed by some to their stimulation of vagus, by others to action on myocardium or cardiac ganglia.

1. OBSTRUCTIVE JAUNDICE.

Causes.—Obstructions arising in the lumen, in the walls, or external to the common bile or hepatic ducts.

FOREIGN BODIES IN THE DUCTS.—Gall-stones.

TUMOURS OF THE DUCTS.

STENOSIS OF THE DUCTS.

EXTERNAL PRESSURE ON THE DUCTS.—Especially : (a) Tumours, of liver, pancreas, and stomach, occasionally kidney, etc. ; (b) Glands in liver fissures.

INFLAMMATORY SWELLING OF MUCOUS MEMBRANE OF DUCTS.—Probably never produces complete obstruction.

CIRRHOSIS AND DIFFUSE DISEASES OF LIVER.—Jaundice slight and inconstant (*see* LATENT JAUNDICE).

2. TOXIC AND INFECTIVE JAUNDICE.

Causes.—Action on the liver produces *hepatitis*.

1. CATARRHAL JAUNDICE.
2. CHEMICAL POISONS. — (a) Organic, e.g., trinitrotoluene, toluylenediamine, tetrachlorethane, chloroform, arsenobenzol, carbon tetrachloride, cincophen (atophan), acetanilide, aniline ; (b) Inorganic, e.g., phosphorus, arsenic, gold.
3. BACTERIAL INFECTIONS.—Pyæmia and septicæmia, pneumonia, typhoid, etc.
4. PROTOZOAL INFECTIONS.—‘Epidemic jaundice’, syphilis, yellow fever, relapsing fever, malaria.
5. TOXÆMIAS.—E.g., pregnancy.

Symptoms.—Vary greatly with the cause, constitutional symptoms resulting from this usually being very severe, and direct symptoms of jaundice little marked. Degree of jaundice often slight in proportion to general symptoms. ‘Typhoidal state’, rapid pulse, dry tongue, hæmorrhages, and death common.

Stools.—Contain stercobilin, and are not always ‘clay-coloured’.

URINE.—Bile pigment usually slight ; may be absent, but urinary pigments increased owing to absorption of stercobilin (identical with urobilin) from intestines.

3. HÆMOLYTIC JAUNDICE.

Causes.—Excessive destruction of red cells. See HÆMOLYTIC ANÆMIA. Include :—

1. Increased fragility of red cells : Acholuric jaundice.
2. Increased destructive agents : e.g., snake-venom, blackwater fever.

II. CATARRHAL JAUNDICE.

An acute jaundice, transient and without final ill-effects.

Pathogenesis.—Now accepted as a hepatitis, i.e., ‘toxic jaundice’. Believed to be transmissible and infectious (in mass conditions). Formerly attributed to inflammatory swelling of the mucous membrane of the common bile-duct, especially near its termination—i.e., obstructive jaundice ; owing to mucus being occasionally found in ampulla, it was attributed to ascending infection from inflammation of duodenum (for this theory there is evidence and it is now generally abandoned) : later ascribed to descending infection of bacterial origin.

EPIDEMIC CATARRHAL JAUNDICE.—Numerous small epidemics, clinically indistinguishable from sporadic catarrhal jaundice, have occurred in schools and institutions. No spirochætes or causal organisms found. Mode of spread unknown. Fatal cases extremely rare (as acute yellow atrophy). Epidemics on large scale in Mesopotamia and elsewhere during War.

Etiology.—

AGE.—*Children and young adults* most frequent, but any age liable. Overwork or worry or chill are not uncommonly the only obvious preceding factors.

Symptoms.—

PREMONITORY SYMPTOMS.—General malaise and gastric disturbance, duration seven to ten days: common, but usually slight. Vomiting occasionally severe.

JAUNDICE.—Bright yellow. Never dark tint of chronic jaundice. Appearance may be early or delayed for 7 to 10 days.

LOSS OF APPETITE.—*Nausea* and vomiting (especially if diet excessive). Headache, furred tongue, and malaise. Symptoms may precede jaundice, and subside as it appears.

TEMPERATURE.—Variable: normal, or 101° to 102° .

SYMPTOMS AS IN OBSTRUCTIVE JAUNDICE.—Bile in urine, clay-coloured stools, constipation, mental depression, itching, slow pulse, bile-tinged serum. No biliary colic, or severe pain. Pains in back and limbs at times.

LIVER.—Often slightly enlarged and tender. Gall-bladder may be palpable: spleen very rarely.

BLOOD.—Leucopenia with relative lymphocytosis.

VAN DEN BERGH'S REACTION.—Positive biphasic.

Course and Termination.—*Duration*, two to five weeks: colour often fades slowly. No after-effects. Fatality, as acute yellow atrophy, extremely rare. Over six weeks' duration suggests carcinoma or gall-stones in adults.

Diagnosis.—May be impossible before jaundice appears. In young subjects rarely difficult subsequently: premonitory malaise; absence of colic, physical signs, and severe symptoms. In older patients, exclusion of carcinoma needs longer observation.

Treatment.—Rest in bed and warmth.

DIET.—Fluids at onset. *Avoid fats*. Progress gradual: (1) Broth, milk, peptonized milk, gruel—for one to three days; then (2) Benger's food, milk puddings, custard, egg-flip, and eggs; (3) Pounded or boiled fish.

BLAND FLUIDS.—Use encouraged. Hot water at onset, especially if vomiting. Then mineral waters, or water with sodium bicarbonate added.

BOWELS.—Free motions, but avoid purging. Calomel, gr. $\frac{1}{2}$ to 2, first evening: then morning salines.

GASTRIC SEDATIVES.—Especially bismuth.

R	Bismuth. Salicylat.	gr. xv	| Tinct. Aurantii	℥xv
	Acid. Hydrocyan. Dil.	℥iij			Aq.	ad 3j
			t.d.s.	

INTESTINAL ANTISEPTICS.—Salol gr. x, t.d.s. Widely used: action doubtful.

DURING CONVALESCENCE.—Avoid chills and heavy diet. Slight jaundice may persist after symptoms subside. Gastric condition is best guide for treatment.

III. ICTERUS NEONATORUM.

Many types. Severer forms (except traumatic) are akin to hæmorrhagic diseases of the new-born.

Physiological Jaundice.—

FREQUENCY.—About 50 per cent of infants. *Onset* within first four days.

JAUNDICE.—Mild; rapidly reaches maximum; duration about two weeks. No symptoms. Conjunctivæ often escape. Liver and spleen not enlarged. Bile in urine rare. No treatment necessary.

CAUSE.—Large destruction of erythrocytes after birth. Is a hæmolytic anæmia: liver normal.

Severe Forms.—

CONGENITAL ABSENCE OF THE BILE-DUCTS (*see* p. 517).

CONGENITAL SYPHILITIC HEPATITIS (*see* p. 231).

SEPSIS.—Usually phlebitis of umbilical vein: severe constitutional symptoms: suppuration of navel: hæmorrhages common. Recovery rare.

Rare Forms.—

EPIDEMIC JAUNDICE OF INFANTS.—Jaundice, diarrhœa, and hæmaturia: may be hæmoglobinuria. Is same as 'Winckel's disease', epidemic hæmoglobinuria. *See* HÆMOGLOBINURIA.

FAMILIAL JAUNDICE.—'Familial icterus gravis neonatorum'. Is a hæmolytic jaundice. *See* HÆMOLYTIC ANÆMIAS OF THE NEWBORN.

ACHOLURIC JAUNDICE.—May date from birth.

IV. ACUTE YELLOW ATROPHY.

A rare acute condition in which hepatitis (affection of parenchymatous liver cells) has advanced to the stage of generalized necrosis of the cells. Characterized pathologically by necrosis of the liver cells and diminished size of liver, and clinically by jaundice, toxæmia, nervous symptoms, small liver, and high mortality.

'*Icterus gravis*' has been used as clinical term for same condition. Is better abandoned.

Predisposing Causes.—Is always secondary. Any form of TOXIC AND INFECTIOUS JAUNDICE may thus develop or terminate: for cause *see* p. 504.

Etiology.—

AGE.—20 to 40 years usually. Rarely in children.

SEX.—Females preponderate (from influence of pregnancy).

Notes on Certain Causes.—

PREGNANCY.—Accounts for at least 30 per cent of all cases. Usually latter half of pregnancy, occasionally in puerperium:

very rare before 4th month. The common foci of necrosis in liver in pregnancy are of same type, but of less extent.

PHOSPHORUS.—Liver usually enlarged, and fat very excessive: but in less acute poisoning, of some duration, liver is identical with other forms, fat probably being absorbed.

Pathogenesis.—Obscure.

FLEXNER'S THEORY OF 'AUTOLYTIC NECROSIS'.—Some toxin kills the liver cells without destroying their autolytic ferments, which then cause necrosis of the dead cells.

Morbid Anatomy.—Is essentially *necrosis* and not *atrophy*.

LIVER.—*Size greatly reduced.* Weight often 20 to 30 ounces or less. Greenish-yellow colour. Flabby. Capsule wrinkled and strips easily: below, may be hæmorrhages. *On section:* yellow and red areas, mottled appearance.

YELLOW AREAS.—Colour due to bile. Contain fat and necrosed cells. *Histology:* Necrosed cells in all stages, hæmorrhages between cells; condition commences in intermediate zone of lobule; cholangitis of small bile-ducts, with increase in number.

RED AREAS.—Later stage of above, fat and necrosed tissue being absorbed. Fibrous tissue and capillaries alone remain (whence colour). Depressed below yellow areas. *Histology:* Often unrecognizable as liver. The longer the duration, the greater is the proportion of red areas.

AMOUNT OF FAT.—Usually somewhat increased, 5 to 10 per cent against normal 3. (In phosphorus poisoning forms 50 to 80 per cent.)

LEUCIN, TYROSIN, and other amino-acids greatly increased: may precipitate as film on cut surface. Origin of leucin and tyrosin probably from liver cell degeneration.

OTHER ORGANS.—Bile-stained, and hæmorrhages numerous. *Kidneys:* epithelial degeneration. *Heart:* fatty degeneration. *Spleen:* usually enlarged. *Blood:* fluid, stains endothelium.

Symptoms.—Two stages:—

1. **FIRST STAGE.**—*Stage of catarrhal jaundice.* Gradual onset: resembling acute catarrhal jaundice, but vomiting frequent. Liver may be enlarged. Duration five days or longer.
2. **SECOND STAGE.**—*Stage of hepatic failure.* Rapid development of severer, and nervous symptoms. Headache, muscular twitching, convulsions or delirium passing to coma and death. Vomiting intractable. Jaundice usually deepens. Abortion if pregnant. *Petechiæ* and hæmorrhages common: skin, mucous membranes, retinæ especially. Cholaemia develops with 'typhoidal state', rapid pulse, dry tongue, etc. Duration two to seven days. Temperature variable: high before death.

LIVER DULLNESS.—Diminishes progressively: even entirely obliterated if liver falls back and distended intestines pass in front.

URINE.—Amount diminished. Bile present. Albumin and casts: usually large quantities. Sugar absent. Excretion of nitrogen

Acute Yellow Atrophy—Symptoms, continued.

as in acidosis: (1) Total nitrogen diminished; (2) Percentage of urea low; (3) Percentage of 'ammonia-nitrogen' very high, 20 to 50 per cent; (4) Amino-acids in excess. *Leucin and tyrosin*, usually present, occasionally form precipitate, but may be absent; presence is not diagnostic of acute yellow atrophy.

CONSTIPATION.—Severe. Stools often darkened with blood, and offensive.

BLOOD UREA low. **ALKALI RESERVE** low. **BLOOD-SUGAR** low.

BLOOD.—Serum bile-stained. Coagulation delayed. Very fluid.

VAN DEN BERGH'S REACTION.—Immediate direct positive.

Diagnosis.—Essential symptoms are: (1) Jaundice; (2) Vomiting; (3) Nervous symptoms; (4) Small liver; (5) Urinary changes.

PHOSPHORUS POISONING.—Distinguished by: (1) Distinct remission between two stages of symptoms; (2) Liver enlarged; (3) Widespread fatty degeneration.

Prognosis.—Mortality very high, especially in pregnancy: less in children. Rarely, improvement and prolongation for weeks, with subsequent death. *Subacute* forms with recovery occur.

Treatment.—As for ACIDOSIS. In pregnancy, the treatment is that of eclampsia.

SUBACUTE YELLOW ATROPHY.

HEALING AND RECOVERY.

Recovery occasionally occurs in condition of acute (or subacute) yellow atrophy after weeks or months.

Morbid Anatomy of Liver.—(Autopsy after long interval from attack.)

MACROSCOPIC.—Liver small and very irregular. Numerous raised rounded nodules, '*multiple nodular hyperplasia*', with intervening depressed area.

HISTOLOGY OF NODULE.—Is area of 'liver regeneration', functioning liver tissue: consists of cells resembling liver cells and others resembling ducts: may be active karyokinesis and proliferation. In dispute whether: (a) Surviving liver cells proliferate and also form new bile-ducts; or (b) Interlobular bile-ducts proliferate, and also produce 'liver cells'. Structure of a normal lobule may or may not be recognizable.

DEPRESSED AREA.—Fibrosis: post-necrotic, no structure.

General appearance intermediate between acute yellow atrophy and forms of cirrhosis of liver.

MORE RECENT CASES.—May be unaffected areas, with intervening areas of active liver regeneration.

Note.—Knowledge of this important condition still very incomplete. Considerable variation, depending on original factor.

V. AFFECTIONS OF THE BLOOD-VESSELS OF THE LIVER.

1. PASSIVE CONGESTION OF THE LIVER.

(*'Nutmeg' Liver. Cardiac Liver.*)

Cardiac 'back-pressure' of any origin causes increased pressure in the efferent vessels of the liver, and hence mechanical congestion, which results finally in pathological changes.

Causes.—

CARDIAC LESIONS.—Especially mitral stenosis.

PULMONARY CONDITIONS.—Emphysema and chronic bronchitis. Interstitial fibrosis of lung. Intrathoracic tumours and aneurysms: very rare cause.

Morbid Anatomy.—

LIVER.—Large, firm, smooth, and dark red. *On section*: Surface mottled, i.e., 'nutmeg', due to zones in the lobules: (a) Intralobular veins dilated (red centre of lobule); (b) In remainder of lobule, cells bile-stained, atrophied, or in fatty degeneration (yellow periphery of lobule).

HISTOLOGY.—Lobule shows: (1) Intralobular veins and their capillaries distended: extent and area vary. (2) Intermediate zone: liver cells compressed, and later atrophy and necrosis: deposit in cells of *brown pigment*, i.e., iron-free hæmatoidin (Prussian-blue test negative). (3) Peripheral zone: often fatty degeneration. Small hæmorrhages between cells.

Connective tissue often increased, but *no marked cirrhosis* when uncomplicated. Hepatic veins dilated and walls thickened.

'CYANOTIC INDURATION'.—In later stages, when chronic, liver may become contracted and tough.

Symptoms.—Dominated by causal disease.

GASTRIC CATARRH, FLATULENCE, ETC. Also when disease is advanced: ascites, slight jaundice, hæmatemesis.

LIVER.—Enlarged: size often varies rapidly, e.g., smaller after hæmatemesis. Tender (measure of severity). *Pulsating liver*: test by anteroposterior examination to differentiate from transmitted pulsation.

Diagnosis.—From cirrhosis by: cardiac and lung lesions, liver surface smooth, no distended abdominal veins.

Treatment.—Open bowels freely (salines or calomel). For severe pain: poultices or leeches. Treatment mainly directed towards cause.

2. THROMBOSIS OF THE PORTAL VEIN.

(*Pylethrombosis. Adhesive Pylephlebitis.*)

Thrombosis occurring without suppuration: condition rare. For *suppurative pylephlebitis*, see ABSCESS OF THE LIVER, p. 532.

Etiology.—May result from any pressure on, or affection of, portal vein or immediate tributaries:—

Thrombosis of the Portal Vein—Etiology, *continued*.

CIRRHOSIS OF LIVER.—In 1 to 3 per cent of cirrhosis (any type, including syphilis). Is commonest cause.

CANCER INVADING OR CONSTRICTING VEIN.—Usually liver, bile-ducts, pancreas, or stomach, or secondary glands.

GALL-STONES.—Invading portal vein.

INFLAMMATION FROM OTHER CAUSES SPREADING TO VEIN.—Inflammation in neighbouring tissues, suppuration in or near liver, gall-bladder, and pancreas.

THROMBOSIS SPREADING FROM TRIBUTARIES.—As from splenic vein (from suppuration, infarct, or other disease), or from superior mesenteric vein.

Many rare and occasional causes, e.g., erythræmia, syphilitic phlebitis, phlebosclerosis, calcification of vein; pregnancy; chronic proliferative peritonitis. No cause may be found: often thrombosis elsewhere.

Pathology.—

PORTAL VEIN.—If thrombosis is recent, vein is distended with clot; walls may be sclerosed. Intestines may be gangrenous if superior mesenteric vein involved, especially jejunum (no anastomosis with parietal veins). In chronic forms, clot organizes and vein becomes a fibrous cord or is canalized; collateral circulation is established. Extent of clot varies, may extend from portal vein into tributaries, or vice versa.

LIVER.—Some atrophy and fibrosis, but often very little change. Infarcts not uncommon.

SPLEEN.—Nearly always enlarged.

The clotting possibly results directly from phlebosclerosis; influence of organisms unknown.

Symptoms.—Vary with: (1) Extent and site of clot; (2) Rapidity of formation. Pre-existing abdominal disease usual.

SUDDEN THROMBOSIS.—Sudden symptoms of engorged portal system: hæmatemesis, enlargement of spleen, ascites, melæna. Superficial abdominal veins sometimes distended. Abdominal pain.

LOCAL SYMPTOMS.—Depend on distribution of clot: e.g., symptoms of intestinal obstruction (mesenteric veins thrombosed).

CHRONIC CONDITION.—Signs of collateral circulation. Hæmatemesis often recurrent. Finally fails, with ascites, etc.

Diagnosis.—Rarely possible. Obscured by primary disease.

Prognosis.—Death usually rapid, few days to few weeks. With carcinoma may be several months. With cirrhosis may be a year or more. Recovery occasionally occurs, with several years of life.

Treatment.—Palliative. In chronic forms, elastic bandages to support superficial veins.

VI. DISEASES OF THE BILE-PASSAGES AND GALL-BLADDER.

1. SUPPURATIVE CHOLANGITIS.

Purulent inflammation of the bile-ducts, large and small. Gall-bladder nearly always involved.

Etiology.—Any condition affecting bile-ducts, and thus rendering them liable to bacterial invasion, but all causes *rare* except gall-stones.

1. GALL-STONES.—Cause of 90 per cent. Severest sequel of gall-stones.
2. ACUTE INFECTIVE CHOLECYSTITIS.—Spread to bile-ducts is rare: possibly cystic duct occluded.
3. CANCER OF DUCTS.
4. ROUND WORMS. FOREIGN BODIES. RUPTURE OF HYDATIDS.
5. SUPPURATIVE PYLEPHLEBITIS.
6. INFECTIOUS FEVERS, e.g., pneumonia and influenza.

Morbid Anatomy.—

COMMON DUCT.—Dilated, often enormously. Walls thick and inflamed.

LIVER.—Enlarged. On section, *multiple small abscesses*: or multiple yellowish areas in process of suppuration: rarely, single large abscess. Hepatic ducts and tributaries distended with bile-stained pus.

GALL-BLADDER.—Usually distended with pus (empyema).

Various adhesions, or fistulæ of ducts or gall-bladder into intestines, pancreatitis, pylephlebitis, peritonitis, pleural effusion. and other effects of extension of pus.

Symptoms.—*Severe sepsis, with previous history of gall-stones.*

ONSET.—Rigors, nausea, great prostration. Temperature variable.

JAUNDICE.—Usually intense, occasionally slight.

PAIN OVER LIVER.—Worse on movement (perihepatitis).

LIVER.—Progressive enlargement. Surface smooth. Tender.

Gall-bladder usually enlarged. Spleen occasionally. Leucocytosis present. Blood culture: various bacteria recorded.

PROGRESS.—Rapid emaciation, prostration, and usually death.

Complications.—Numerous from spread of pus and septicæmia: suppurative pylephlebitis, pancreatitis, peritonitis, pleural effusion, endocarditis. When spontaneous recovery, fistulæ and strictures of ducts.

Diagnosis.—

CHARACTERISTICS.—Severe sepsis, jaundice, enlarging liver, history of gall-stones, *symptoms progressive.*

Suppurative Cholangitis, continued.**DIAGNOSIS FROM.—**

1. STONE IN AMPULLA OF VATER.—Free intervals, with recurrent attacks of syndrome: jaundice, colic, rigors, sweats, and fever (*see* p. 524).
2. PYLEPHLEBITIS.—May coexist. Symptoms similar. Usually from appendix.
3. TROPICAL ABSCESS OF LIVER.

Prognosis.—Mortality high. With liver abscess formation, all fatal. Recovery depends upon evacuation of pus in ducts before involvement of liver, by (1) operation—prognosis fair, (2) fistulæ, and discharge into intestines spontaneously.

Treatment.—Immediate operation, evacuation of pus, and drainage.

2. CHOLECYSTITIS.

Cholecystitis, inflammation of the gall-bladder, is due to infection with bacteria.

PATH OF INFECTION.—Bacteria may reach gall-bladder by: (1) Blood-stream; (2) Extension from the ducts, e.g., from the duodenum. *Note:* Duodenum is normally sterile, but is rapidly infected in achlorhydria.

BACTERIA.—*B. coli*, enteric group, streptococci, staphylococci commonly.

ETIOLOGY.—Age, sex, predisposing causes: as in GALL-STONES.

CLASSIFICATION of types of cholecystitis is impossible on simple lines. It may be: (a) Acute, subacute, or chronic; (b) Catarrhal, suppurative, or phlegmonous (fulminating). All combinations of (a) and (b) occur, either with or without gall-stones; further, the grade of inflammation may progress rapidly from catarrhal to phlegmonous; or chronic forms may become acute.

The following types will be described: (1) Acute catarrhal; (2) Chronic catarrhal; (3) Chronic suppurative; (4) Acute suppurative.

1. Acute Catarrhal Cholecystitis.—

ETIOLOGY.—May be: (1) Gall-stones; (2) Infections, e.g., typhoid; (3) No cause found.

MORBID ANATOMY.—

SLIGHT FORMS.—Simple inflammatory changes or strawberry gall-bladder.

SEVERER FORMS.—Gall-bladder distended and tense; walls thickened; mucous membrane congested and covered with mucus, and often ulcerated; contents either serous or turbid sero-fibrinous or bile-stained fluid; gall-stones usually present in gall-bladder or duct; cystic duct often occluded. Adjacent lymphatic glands enlarged. Adhesions to colon, etc., common.

SYMPTOMS.—Mild grades often undiagnosable or overlooked, as dyspepsia, etc. In *severer forms* :—

1. **PAIN.**—Varying degrees. May be severe and paroxysmal. Usually over liver (as in colic); may radiate to angle of right scapula, or occasionally to shoulder. Occasionally in right iliac fossa, or epigastrium.
2. **TENDERNESS.**—Marked. General, and then localizing near 9th rib.
3. **JAUNDICE.**—Absent. (Occasionally present, if inflammation spreads to or stone present in common bile-duct.)
4. **GALL-BLADDER.**—Usually palpable. May be obscured by rigidity of muscles.
5. **LIVER.**—Not usually enlarged. Rectus rigid. Hyperæsthesia of eighth and ninth dorsal segments. Moderate gastric disturbance. Temperature raised. Polynucleosis.

COURSE.—Mild cases recover in few days. Usually recurs and progresses to chronic cholecystitis.

SEQUELÆ.—

1. Chronic cholecystitis.
2. *Adhesions*: to stomach, etc., causing gastric disturbances, often vague.
3. *Empyema of gall-bladder*: chronic form (see p. 514).
4. May progress to severe forms, e.g., phlegmonous cholecystitis or acute empyema.

DIAGNOSIS.—From appendicitis, pyelophlebitis.

From *gall-stones*: very difficult: note severity of pain. In *suppurative cholecystitis*: constitutional disturbances greater. *Cholecystography* rarely of assistance.

2. Chronic Catarrhal Cholecystitis.—

ETIOLOGY.—Often sequel of gall-stones. May be chronic from onset, or follow acute cholecystitis.

MORBID ANATOMY OF GALL-BLADDER.—May be definitely enlarged, and lumen distended with ropy mucus; no bile present. Adhesions common. *Walls* thickened with fibrous tissue; little normal mucosa remains.

Every intermediate grade occurs between this and cholecystitis obliterans.

SYMPTOMS.—Chronic dyspepsia of following character: (1) *Epigastric discomfort*. Irregular in occurrence, time of onset, and relation to food. Site variable, mainly right hypochondrium; may radiate to angle of right scapula. Unaffected or slightly relieved by alkalis, vomiting, or food. (2) Sensation of fullness in the epigastrium. (3) Nausea; may be vomiting. (4) Jaundice absent. Bowels vary, may be constipation or diarrhœa. No pyrexia.

PHYSICAL SIGNS.—May be: (1) Tenderness at gall-bladder area; Murphy's sign, viz., pain on taking deep breath during

Chronic Catarrhal Cholecystitis—Symptoms, *continued*.

palpation. (2) Rigidity of right rectus. Occasionally tenderness and rigidity of right lower intercostal muscles.

Attacks of pain resembling biliary colic may occur; gall-stones usually present and condition is identical with forms of chronic cholelithiasis; but occasionally on operation no evidence of calculi found.

COURSE AND SEQUELÆ.—Progressive. Attacks may simulate *migraine*, or cardiac symptoms, e.g., precordial pain, palpitations. Adhesions may form to *duodenum* and other organs, causing vague disturbances. *Riedel's lobe* may enlarge over gall-bladder. *Chronic appendicitis* may coexist.

DIAGNOSIS.—From gastric and duodenal ulcer; myocardial lesions; arthritis of spine; chronic appendicitis.

CHOLECYSTOGRAPHY (tetraiodophenolphthalein).—Shadow of gall-bladder feeble or absent, or does not empty after fat meal; may be distorted by adhesions.

DUODENAL CONTENTS.—Bile contains mucus, epithelial cells, pigment granules; may be pus cells and bacteria.

TREATMENT.—

MEDICAL.—Hexamine with alkalis. Mag. sulph. 3j to 3ij, early morning.

SURGICAL.—Operate if repeated attacks.

CHOLECYSTITIS OBLITERANS (*Atrophic Cholecystitis*).—

ETIOLOGY.—Sequel of gall-stones and chronic cholecystitis.

GALL-BLADDER.—Contracted even to a fibrous cord; may be hugging a stone; adhesions common.

SYMPTOMS.—Pain and ill-health from adhesions: may be passage of some ropy mucus.

Calcification may follow either of above forms.

3. Chronic Suppurative Cholecystitis (*Empyema of Gall-bladder*).

—Pus slowly forms in gall-bladder as sequel to acute catarrhal cholecystitis.

SYMPTOMS.—Acute symptoms subside. Then gradually malaise, anorexia, abdominal pain, and gall-bladder tumour: temperature slight. Due to slow formation of pus.

SEQUELÆ.—

1. **PERFORATION.**—(i) General peritonitis, but adhesions often prevent this; (ii) Local abscess formation, e.g., subphrenic abscess; (iii) Into duodenum, colon, etc. (after adhesions); (iv) May point through the skin.
2. **INFLAMMATION SPREADS** through wall to neighbouring structures (local peritonitis).
3. **ADHESIONS.**—Resulting from spread of inflammation.
4. **SUPPURATIVE CHOLANGITIS.**—Rare, owing to occlusion of duct.

Polynucleosis. *Appendicitis* may coexist. *Intestinal obstruction* may be simulated.

OPERATIVE RESULTS.—Generally good, but condition serious.

Note.—Empyema of gall-bladder may be: (1) Chronic, in this type; (2) Acute, in acute suppurative type (*see below*).

4. **Acute Suppurative Cholecystitis** (*Acute Empyema*).—

MORBID ANATOMY.—Gall-bladder contains pus. Walls in state of acute inflammation, of varying severity.

SYMPTOMS.—

CONSTITUTIONAL.—Often of great severity. Signs of sepsis: rigors, rapid pulse, vomiting, high temperature, prostration.

May be intestinal distension and symptoms of local peritonitis.

LOCAL.—(As in acute catarrhal cholecystitis.) Pain of all grades of severity to acute colic. May be masked by severity of general condition.

SEQUELÆ.—As in chronic suppurative cholecystitis, but of great severity and rapidity.

DIAGNOSIS.—Difficult. Symptoms do not localize lesion. Previous history of gall-stones (or enteric) important. Diagnosis from:—

1. **DISEASE OF ABDOMINAL ORGANS NEAR LIVER**, e.g.: (i) Perforated duodenal ulcer; (ii) Right acute pyelonephritis (pus in urine)—symptoms of these may be closely similar; (iii) Subphrenic abscess.

2. **DISEASE OF RIGHT BASE.**—Pneumonia and pleurisy.

3. **APPENDICITIS.**

4. **ACUTE INTESTINAL OBSTRUCTION.**—Occasionally.

PROGNOSIS AND TREATMENT.—Prognosis depends partly on early operation. Mortality always considerable.

PHLEGMONOUS CHOLECYSTITIS.—Is very rare. *Symptoms* resemble suppurative form, but of great severity and rapidity: toxæmia extreme, jaundice not uncommon. Gall-bladder swollen, œdematous, and very friable. Rapid sloughing, perforation, and general peritonitis usual: adhesions rare, from short duration. *Treatment*: immediate operation and removal. Mortality very high.

GANGRENOUS CHOLECYSTITIS.—A sequel of the above.

3. **CANCER OF THE GALL-BLADDER AND BILE-DUCTS.**

Cancer of the Gall-bladder.

Etiology.—

NATURE OF GROWTH.—*Primary carcinoma.* All others very rare.

AGE.—55 to 65 years.

SEX.—Females 3 or 4 to 1 male.

RELATION TO GALL-STONES.—*Gall-stones present in 75 to 90 per cent.* Note also: (a) Catarrh present in only 10 per cent of secondary growths; (b) Carcinoma develops in 5 to 15 per cent of gall-stones. *Conclusion*: Gall-stones are cause and not result of the carcinoma, another factor (probably chronic inflammation) also being necessary.

Cancer of the Gall-bladder, *continued*.

Morbid Anatomy.—

CARCINOMA.—Columnar or spheroidal cells. Growth either infiltrates and thickens wall, or projects into lumen as villous fungating mass.

SITE OF ORIGIN.—Fundus usually. Less often, entire bladder, or at neck.

LIVER.—Secondary growths in 50 per cent. In others, usually distension with bile.

BILE-DUCTS.—Frequently involved by spread of growth. Original site often uncertain.

ABDOMINAL GLANDS.—Also affected.

Secondary growths rare elsewhere.

Symptoms.—(Elderly woman, often previous history of gall-stones.)

DISCOMFORT.—In right hypochondrium. May be PAIN: severe and paroxysmal, and superficial tenderness (8th dorsal segment).

JAUNDICE.—Occasionally absent.

LOSS OF WEIGHT: ANOREXIA.

GALL-BLADDER TUMOUR.—In over 50 per cent. Becomes hard and irregular.

LIVER.—Usually enlarged.

Symptoms are progressive.

Jaundice results from liver growths, or glands in portal fissure, or bile-duct involvement.

Supraclavicular gland may be enlarged.

CHOLECYSTOGRAPHY.—Filling defects.

Duration.—Six months from jaundice. Death in 'cholæmia'.

Complications.—Suppurative cholecystitis, cholangitis. Adhesions to pylorus, etc. Fistulæ into colon, etc. Portal vein thrombosis. Ascites (pressure on portal vein).

Diagnosis from Gall-stones.—Difficult. Age. Progressive jaundice and cachexia. Palpable gall-bladder (*see* COURVOISIER'S LAW, p. 525). Secondary growths in liver often decide.

Note.—At operation a chronically inflamed gall-bladder may be hard and thick, and distinction uncertain.

WHEN LIVER INVOLVED.—Symptoms indistinguishable from hepatic carcinoma, and *when bile-ducts* involved, from carcinoma of bile-ducts or head of pancreas.

Treatment.—Operation and removal, if liver not involved. Considerable mortality from hæmorrhage.

Other Tumours of Gall-bladder.—*Secondary growths* very rare; no relation to gall-stones; males preponderate.

Innocent tumours: very rare.

Cancer of the Bile-ducts.

Etiology.—

NATURE OF THE GROWTH.—*Primary carcinoma.*

AGE.—55 to 65 years.

SEX.—Males, slight majority.

GALL-STONES.—Present in about 30 per cent.

Morbid Anatomy.—

CARCINOMA.—Usually columnar cells, occasionally spheroidal.

GROWTH.—(1) Projects into lumen, size not greater than cherry ;

(2) More commonly, infiltrates wall, producing stricture. *Origin* : commonest near termination. Tends to spread along ducts, even to gall-bladder, or into pancreas.

BILE-DUCTS.—Distended above growth.

GALL-BLADDER.—Is always distended, unless prevented by adhesions from previous cholecystitis.

LIVER.—*Deep green colour.* Not always enlarged. Secondary growths in 20 per cent (low percentage ascribed to rapid death from cholæmia).

Symptoms.—*Onset insidious.* Resembles severe catarrhal jaundice with cachexia.

JAUNDICE.—Usually earliest symptom. *Steadily increases to dark green.*

CACHEXIA.—Loss of weight. Anorexia.

PAIN.—Absent or slight : occasionally biliary colic.

GALL-BLADDER.—Palpable : surface *smooth.* Primary growth never palpable.

LIVER.—Usually palpable. Extension of growth may render the symptoms identical with carcinoma of gall-bladder, head of pancreas, or liver.

TUMOUR OF HEPATIC DUCT.—As above, but gall-bladder not enlarged.

TUMOUR OF CYSTIC DUCT.—As cancer of the gall-bladder. No jaundice.

Duration.—Six months from onset of jaundice. Death due to 'cholæmia', or suppurative cholangitis.

Complications.—Rare : portal thrombosis, rupture of distended gall-bladder, hæmorrhage from growth.

Diagnosis from Gall-stones.—By : (1) Age ; (2) Insidious onset ; (3) Progressive jaundice and cachexia ; (4) Enlarged gall-bladder. See CARCINOMA OF GALL-BLADDER.

Treatment.—Cholecystenterostomy may temporarily relieve gall-bladder and liver.

4. STENOSIS AND OBSTRUCTION OF THE BILE-DUCTS.

Congenital Obliteration of the Bile-ducts.

Situation and Extent of Obliteration.—Varies ; usually in common duct, generally extending into common hepatic duct.

Morbid Anatomy.—

BILE-DUCTS.—Great fibrous thickening. Lumen may be recognizable microscopically, but no epithelial cells are present. *No dilatation* above constriction.

LIVER.—Enlarged, hard, and bile-stained. *Histology* : Marked cirrhosis, unilobular, and in parts multilobular. Gall-bladder almost obliterated.

SPLEEN.—Enlarged.

Congenital Obliteration of the Bile-ducts, continued.**Pathogenesis.**—Origin may be:—

1. CONGENITAL MALFORMATION.—On this theory, cirrhosis of liver is secondary.

Note.—In adults, neither enlargement of liver nor marked cirrhosis follows obstruction of ducts.

2. ACTION OF PLACENTAL TOXINS.—Toxins partly: (1) Reach liver direct, causing multilobular cirrhosis; (2) Reach liver (and spleen) in general circulation, are excreted into bile, causing unilobular cirrhosis of liver and fibrosis of bile-ducts. Probable explanation.

3. CONGENITAL SYPHILIS.—A very rare cause.

Constriction by chronic peritonitis is on record.

Symptoms.—*Jaundice*: onset at birth, or within two weeks: progressive and severe. Emaciation and hæmorrhages, especially from cord, usually precede inevitable death, which frequently occurs in convulsions. No pyrexia.

Diagnosis.—From other forms of *ICTERUS NEONATORUM* (see p. 506).

Stenosis of the Bile-ducts.

Stenosis or stricture may be: (1) *Congenital* (see above); (2) *Acquired*. Extremely rare as result of gall-stone ulceration, except in cystic duct (see *CHOLELITHIASIS*). Annular carcinoma of duct may simulate stenosis.

Obstruction of the Bile-ducts.

Etiology practically identical with obstructive jaundice.

VII. CHOLELITHIASIS: GALL-STONES.**ORIGIN AND FORMATION OF GALL-STONES.**

Gall-stones consist mainly of cholesterol and calcium bilirubin. The chief problems are: (1) The origin of the cholesterol; (2) The cause of precipitation; (3) The mode of growth of the stones.

Older Theories.—

1. STAGNATION AND INSPISSATION OF BILE.—Abandoned when it was found that concentration of bile does not by itself result in precipitation of solids.
2. THUDICHUM'S CHEMICAL THEORY.—Sodium glycocholate was supposed to decompose, during stagnation, into glycoll, cholic acid, and a sodium salt; and hence the cholesterol, being little soluble in acid solutions, was deposited, i.e., *the precipitation resulted from a change in reaction.*

These theories accepted presence of cholesterol as due to normal secretion from the blood.

Naunyn's Inflammatory Theory.—

1. ORIGIN OF THE CHOLESTEROL.—(i) Cholesterol and calcium are products of disintegration of cells, i.e., *the result of a mild inflammation of the mucous membrane.* (ii) *Micro-organisms* are the cause of the inflammation.

2. **MODE OF PRECIPITATION.**—Calcium combines with bilirubin, and forms a precipitate, acting as a nucleus on which cholesterol is deposited.

Naunyn's theory of a 'lithogenic cholecystitis' became accepted fundamentally, both as to essential presence of inflammation, and as to origin of cholesterol, viz., from disintegrating mucous membrane due to action of bacteria, and not from blood and bile.

NOTES ON ACTION OF BACTERIA RELATING TO THIS THEORY.—

- i. Bile is favourable medium for bacteria, especially of coli-typhoid group.
- ii. Gall-stones have been experimentally produced by injecting attenuated typhoid cultures into gall-bladders. Gall-stones placed in normal gall-bladders are absorbed.
- iii. Gall-stones are definitely related to enteric fever. Coli-typhoid bacilli frequently present in stones.

KRAMER'S MODIFICATION.—

Naunyn's theory ascribed no importance to reaction of bile.

Note :—

- i. Cholesterol is insoluble in water, soluble in alkaline solutions, especially with bile acids, but little so in acid solutions.
- ii. Cholesterol is also formed in disintegration of mucous membrane other than gall-bladder, and is present in cysts in large amounts, but does not precipitate, reaction being alkaline. Naunyn's explanation: nucleus of calcium bilirubin absent.
- iii. Coli-typhoid bacilli are acid producers.

Kramer's theory: *The bacteria, by altering to acid the reaction of the medium, favour deposition of the cholesterol produced by their action on the mucous membrane.*

Modern Investigations and Theories.—Naunyn's views were long upheld, though not explaining rare occurrence of pure cholesterol calculi without inflammation of gall-bladder. Fresh questions and factors gradually arising included :—

- a. **CONCENTRATION OF BILE.**—By absorption of fluid in gall-bladder, bile is concentrated about 10 times.
- b. **REACTION OF BILE.**—Normal bile is alkaline, but in the gall-bladder alkalinity gradually diminishes and it may become acid. Reaction may also be affected by acid-forming bacilli.
- c. **CHOLESTEROL.**—A considerable amount (150 to 220 mgm. per cent) is normally present in blood and in bile. Is absorbed from intestine, finally reaches liver in the blood, is excreted into bile, and reabsorbed. Origin in blood partly (a) exogenous from food: (b) endogenous formation by cortex of suprarenal and by corpus luteum, especially in pregnancy. Amount in blood, *but not in bile*, can be greatly increased by feeding. Note :—
 - i. It can be precipitated from human bile by rendering reaction acid.

Gall-stones—Modern Investigations and Theories, continued.

- ii. Amount in blood is increased in pregnancy and in typhoid, in both of which gall-stones are common. Also in jaundice, in diabetes, in chronic nephritis, in adiposity, and during menstruation.
 - iii. Amount in blood falls after removal of gall-bladder; also in acute fevers except typhoid.
 - iv. It is relatively insoluble in acid solutions.
- d. DOES THE GALL-BLADDER EITHER ABSORB OR SECRETE CHOLESTEROL?—At present in dispute: some evidence both for absorption and secretion, but it does one or the other and is not merely passive.
- e. RELATION OF BILE-PIGMENTS TO PRECIPITATION OF CHOLESTEROL.—Now known: (i) Solubility of cholesterol in bile normally depends on amount of bile salts present; (ii) Bile salts low when gall-stones present (cause unknown). Hence it appears that cholesterol even in normal concentration may precipitate if bile salts are deficient.

Three factors now recognized:—

1. INFLAMMATION OF BACTERIAL ORIGIN (Cholecystitis).—Based on usual presence of organisms and evidence given above.—Regarded as interfering with normal functions and reaction of gall-bladder, and not as means of actually producing cholesterol. Presence is not absolutely necessary (shown by cholesterol calculi with absence of inflammation).
 2. CONCENTRATION OF CHOLESTEROL IN BLOOD AND BILE.—Precipitation depends on: (a) Alteration of reaction; (b) Concentration of bile during stasis; (c) Amount of cholesterol; (d) Concentration of bile salts.
 3. STASIS.—Thereby: (a) Concentration of bile proceeds further; (b) Alteration of reaction proceeds further.
- Any two of these factors provide conditions necessary for formation of calculi. Hence there are two modes of formation of gall-stones:
- (1) *Aseptic*: Rare cholesterol calculi. Factors: (i) Increased cholesterol; (ii) Bile reaction becomes acid during stasis.
 - (2) *Inflammatory*: Usual mode. Factors: (i) Nuclei of calcium bilirubinate, etc.; (ii) Bacteria acidify bile.

COMPOSITION AND VARIETIES OF GALL-STONES.

1. PURE CHOLESTEROL STONES.—Uncommon. Solitary, large, smooth, yellowish, translucent appearance. Consist of crystalline cholesterol 98 per cent. Usually nucleus of pigment. Formed in gall-bladder when cystic duct blocked. Not visualized by X rays.
2. LAMINATED CHOLESTEROL STONES.—Externally resemble pure cholesterol. On section laminae of cholesterol and calcium biliverdin (green) or calcium bilirubin (brown). Cholesterol forms 75 to 90 per cent.

3. **COMMON GALL-STONES.**—Mixed cholesterol and calcium bilirubin. Consist of: (i) Nucleus—some débris; (ii) Crystalline body of cholesterol, calcium bilirubin and biliverdin, traces of CaCO_3 ; (iii) Non-crystalline crust. Soft and greasy when fresh, hard when dry.
4. **PURE CALCIUM-BILIRUBIN STONES.**—Form in hepatic ducts. Size, pea to grain of sand. Shape, irregular. Occur as: (i) Soft and brown; (ii) Hard, metallic lustre. In acholuric jaundice.
5. Rare forms occur, e.g., calcium carbonate (extremely rare in man, common in animals).

NUMBER.—Often multiple.

SHAPE.—In gall-bladder are roundish. If moderately numerous, are faceted. In common duct, are elongated.

SITUATION.—In gall-bladder only, in over 50 per cent; both in gall-bladder and other sites, in over 30 per cent.

ETIOLOGY.

AGE.—Usually over 40 years. Rare under 30 years.

SEX.—Females preponderate, 75 per cent.

PREDISPOSING FACTORS.—Factors producing stasis: sedentary occupations, lax abdominal walls, constipation, obesity. Pregnancies. Specific infections of gall-bladder, e.g., enteric, and stagnation of bile. Rarely: acholuric jaundice.

FREQUENCY.—In 5 to 12 per cent of autopsies. Commoner in Germany than in Great Britain and America.

DIET.—Influence is uncertain. Fats and eggs especially cause increase of cholesterol in blood.

SYMPTOMS.

Classification of Symptoms.—Symptoms of gall-stones are very numerous. Arise from: (a) Mechanical effects; (b) Results of inflammation, simple or suppurative, local or general. The symptoms also vary with the site of the stone, the degree of obstruction, and other factors. They are accordingly arranged in this section under the groups: (1) Biliary colic, general account; (2) Obstruction of the cystic duct; (3) Obstruction of the common duct; (4) Remote effects of gall-stones.

LATENT SYMPTOMS.—Symptoms are often latent for long periods, or stones found only at autopsy.

PRODROMAL SYMPTOMS.—Irregular dyspeptic symptoms due to CHRONIC CATARRHAL CHOLECYSTITIS. See p. 513.

1. Biliary Colic.—

GENERAL DESCRIPTION.—

PAIN.—

Onset.—Sudden: occasionally previous shivering. Most common at night. May follow a journey or exertion.

Site.—Right hypochondrium. Not uncommon in epigastrium at onset. Rarely, left hypochondrium.

Gall-stones—Symptoms—Biliary Colic, continued.

Radiates widely.—To angle of right scapula, and to right shoulder. Less distinctively, across abdomen.

Character.—Agonizing and paroxysmal. No relief in any position, or from pressure. Severe on deep breath.

Termination.—Gradually eases: leaves dull ache. Rarely, sudden relief.

Duration.—Usually three to twelve hours. Subsequently much prostration. May recur after short interval.

Cause of pain.—*Muscular spasm* excited by impaction of stone in neck of gall-bladder. Movement of stone in bile-passages. Accessory causes: (a) Acute inflammation due to stone; also possibly: (b) Shape of Heisterian valves; (c) Distension of gall-bladder by secretion. First attack usually severest: later, ducts dilated.

Accidents during a paroxysm.—Fatal syncope; rupture of gall-bladder. Rare.

RESTLESSNESS.—Shivering. Cold but sweating. Facies pale. May be precordial discomfort.

VOMITING.—May ease pain, by relaxing gall-bladder spasm.

PULSE.—Small and feeble. Condition of collapse.

TEMPERATURE.—Often 100° (cholecystitis). May be higher.

TENDERNESS.—Marked at gall-bladder spot—midway between tip of 9th rib and umbilicus. Right rectus often rigid. Subsequently persists for several days, depending on severity: (1) Gall-bladder area: *Murphy's sign*: pain on taking deep breath during palpation. (2) Right lower intercostal muscles: not constant.

LIVER.—Very tender: may be enlarged. Similarly gall-bladder. Palpation during spasm unsatisfactory.

AFTER-EFFECTS.—

JAUNDICE.—Does not occur unless stone reaches common bile-duct, or inflammation spreads to it: in latter case, jaundice slight and transient. *Onset*: A few hours to two or three days after colic.

CONSTIPATION.

REPEATED ATTACKS.—Common: mild or severe.

1. **WITHOUT JAUNDICE.**—Stones impacting at neck of bladder.

2. **WITH JAUNDICE** (often slight and transient).—Stones passing down cystic and common duct. Usually others in gall-bladder.

DIAGNOSIS.—Characteristics: (1) Colic; (2) Subsequent jaundice; (3) Often previous attacks; (4) Stone passed in fæces (stir in 1-20 carbolic, and strain through muslin). Diagnosis from:—

CORONARY THROMBOSIS.

RENAL COLIC.—Radiation of pain: no jaundice.

ACUTE GASTRITIS.—Pain less; rigor rare; no collapse.

DUODENAL AND GASTRIC ULCER.—(Closely resembled by chronic gall-bladder with adhesions.) (a) Pain daily and regular; (b) No radiation to shoulder; (c) Less paroxysmal; (d) Gastric contents show free HCl increased (in gall-stones normal or usually diminished).

MOVABLE KIDNEY.—Worse by day; pain less; no collapse.

APPENDICITIS.—Biliary colic referred to iliac fossa is very rare.

HYSTERIA.—By other signs. Pain often periodical.

ACUTE CHOLECYSTITIS.—Symptoms may be identical.

OTHER CONDITIONS.—Pleurisy and pneumonia at right base.

Lead colic. Tabetic crises. Malignant disease. Acute pancreatitis (profound collapse). Acute pyelitis.

Note.—Gall-stones (or cholecystitis), duodenal ulcer, and appendicitis coexist not very rarely.

2. Obstruction occurring in Cystic Duct.—General symptoms of biliary colic. Sequelæ may be:—

1. DILATATION OF GALL-BLADDER (*Hydrops Vesicæ Felleæ*).—

Tumour may be very large. Contents: (a) Acute obstruction: bile and mucus. (b) Chronic obstruction: clear mucus. Sequelæ: (i) Suppuration, specially chronic empyema; (ii) Atrophy.

2. ACUTE CATARRHAL CHOLECYSTITIS.—Common, and is largely cause of symptoms.

3. SUPPURATIVE CHOLECYSTITIS.—Either: (i) Acute; or (ii) *Chronic simple empyema*.

4. CHRONIC CHOLECYSTITIS AND ATROPHY OF GALL-BLADDER.—Not infrequent. All grades from enlarged hard organ to fibrous cord.

JAUNDICE absent in cystic duct obstruction, or slight degree from inflammation spreading along duct.

3. Obstruction occurring in Common Duct.—Commonest site is near termination. General symptoms of biliary colic.

Three groups: (1) Complete obstruction; (2) Incomplete obstruction; (3) Ball-valve obstruction.

1. COMPLETE OBSTRUCTION.—(Rare.) Symptoms:—

ONSET.—Attack of epigastric pain or biliary colic (usually previous attacks) followed by—

JAUNDICE.—Deep; long duration; *intensity unvarying*.

GALL-BLADDER.—Not enlarged (unless calculus at junction with cystic duct). Liver enlarged.

NO SYMPTOMS OF SEPSIS.

STOOLS.—Clay-coloured.

URINE.—Contains bile.

VAN DEN BERGH'S REACTION.—Direct positive.

DIAGNOSIS.—From carcinoma by: (a) Biliary colic; (b) Gall-bladder not enlarged.

TREATMENT.—Operation if jaundice persists (stone occasionally 'works loose' and passes).

Note.—Bile-ducts dilated with clear fluid, 'white bile'. See p. 526.

2. INCOMPLETE AND INTERMITTENT OBSTRUCTION.—

Common. Repeated attacks as stones pass through duct.

Symptoms:—

JAUNDICE.—Intensity varying; long duration.

GALL-BLADDER.—Not enlarged.

LIVER.—Not enlarged. No ascites. Spleen may be palpable.

Gall-stones—Obstruction occurring in Common Duct, *continued*.

BILE.—Present in urine. Fæces vary.

FEVER.—Occasionally: from catarrhal cholangitis.

VAN DEN BERGH'S REACTION.—Direct positive.

TREATMENT.—See p. 527.

MORBID ANATOMY.—Common duct and all ducts dilated: walls thickened, inflamed, but no ulceration. Gall-bladder small: walls thickened: adhesions common. Liver often small: fibrosis around ducts.

COMPLICATION.—*Suppurative cholangitis* (see p. 511): symptoms of intense sepsis, high temperature: rapidly fatal.

3. **BALL-VALVE OBSTRUCTION** ('HEPATIC INTERMITTENT FEVER').—Special symptoms associated with a movable calculus, usually in ampulla of Vater: '*ague*' *paroxysms* of *chills*, *sweats*, and *fever* due to catarrhal pancreatitis.

JAUNDICE.—Variable: absent or present and deeper after paroxysm.

DURING PAROXYSM.—(a) Pain over liver; (b) Vomiting and gastric pain.

PAROXYSMS.—Of great severity; temperature 103° to 105° : may recur daily or periodically, as in malaria.

IN INTERVALS.—Temperature normal. General health remains good. Paroxysms are not proof of sepsis: may recur for years without suppuration.

Attacks due to bile or intestinal contents entering duct of Wirsung and causing pancreatitis. Only condition apart from malaria, in which rigors recur over many years with fair health. Now very rare.

PROGRESS.—Intermissions become less complete and health deteriorates. Chronic inflammation may finally produce *hard fibrous mass*, enclosing stone or muddy débris. Cholangitis may develop, with signs of sepsis. Pancreas may be disintegrated.

DIAGNOSIS.—From: (1) Malaria; (2) Suppurative cholangitis (may be sequel); (3) Carcinoma of bile-ducts or pancreas.

TREATMENT.—Operation.

4. Remote Effects of Gall-stones.—

1. BILIARY FISTULÆ.—

INTESTINAL.—(a) Duodenum: most common, calculus may cause intestinal obstruction. (b) Colon: next in frequency; often no symptoms.

Rarely, fistulæ recorded in other directions, gastric, renal, etc.; cutaneous, usually at umbilicus.

2. **PERFORATION INTO PERITONEUM**.—Usually from acute cholecystitis. Perforation may result in: (a) Local abscess; (b) General peritonitis, or this may follow former. *Symptoms*: Peritonitis with localizing symptoms: (i) Sudden pain near liver; (ii) Rapid jaundice (peritoneal absorption of bile).

3. **INTESTINAL OBSTRUCTION** (see **INTESTINAL OBSTRUCTION—GALL-STONES**, p. 477).—Usually elderly women. Stone enters duodenum by fistula, and impacts in ileocæcal valve.

4. **ADHESIONS.**—Common. Produce vague pains (chronic and nagging) varying with organ affected. Pylorus and stomach common.
5. **CHRONIC CHOLECYSTITIS.**
- ▶ 6. **CARDIAC SYMPTOMS.**
7. **CARCINOMA.**
8. **PANCREATITIS.**—Rare.
9. **STRICTURE OF BILE-DUCTS.**—*Extremely rare* except in cystic duct. *Symptoms* variable: (i) Cystic duct: colicky pain: previous adhesions prevent enlargement of gall-bladder. (ii) Common duct: progressive jaundice, and great liver enlargement: symptoms identical with carcinoma.

VARIOUS FEATURES.

Cholecystography.—Tetraiodophenolphthalein given (Graham). Contra-indicated by renal or cardiac disease, but toxic results now much diminished. Preliminary radiograph of abdomen essential. Fat-free diet for day before dye taken. Radiograph 12 hours after administration. Main results:—

NORMAL GALL-BLADDER.—(1) Shadow present 12 hours after dye; (2) Shadow much reduced 3 hours after meal with fat.

NO SHADOW.—Occurs in: (1) Diseased gall-bladder, e.g., stones, blocked cystic duct, chronic cholecystitis; (2) Impaired liver function; and (3) Dye not absorbed.

CALCULI.—Show as 'ring shadows'. Transparent calculi may show as pale areas surrounded by dye. *Diagnosis* from: renal calculi, calcified glands, calcified costal cartilage.

Note.—Calculi containing calcium show in controls (usual over 40 years).

Courvoisier's Law.—'When the common duct is obstructed by a stone, dilatation of the gall-bladder is rare; when the duct is obstructed by other causes, dilatation is common.' (Great importance in diagnosis.) Absence of enlargement with gall-stone ascribed to previous inflammation causing adhesions and fibrosis.

COROLLARY TO THE LAW.—In jaundice due to gall-stones the gall-bladder is usually small; when due to carcinoma it is usually enlarged.

NOTES ON THE LAW.—(a) Stone in cystic duct: gall-bladder enlarges (jaundice usually absent). (b) Carcinoma with previous stones: gall-bladder small. (c) Chronic cholecystitis: gall-bladder may be enlarged.

Biliary Colic in Absence of Calculi.—Formerly attributed to stones having been passed. Also following explanations:—

1. **'STASIS GALL-BLADDER'.**—Attributed to disturbances of neuro-muscular mechanism of the gall-bladder and Oddi's sphincter and bile-ducts, or to kinking of cystic duct. Gall-bladder and sphincter may both be hypertrophied, or conversely both atrophic.

Gall-Stones—Various Features, *continued*.

2. **CHOLESTEROSIS OF GALL-BLADDER** ('Strawberry Gall-bladder'—Boyd).—Wall covered with minute yellow opaque spots, being deposits of cholesterol beneath surface of epithelium. Polypoid masses may break off and form basis for cholesterol calculus, often present. Probably error either in absorption or excretion of cholesterol. Symptoms may resemble cholecystitis or mild colic.

Oddi's Sphincter and Effects of Cholecystectomy.—Oddi's sphincter, at termination of common bile-duct, normally relaxes when gall-bladder contracts, permitting passage of bile; as with food or magnesium sulphate in stomach. Otherwise is tonically contracted: can resist pressure of 200 to 300 mm. H₂O. Spasms or abnormalities of contraction of sphincter, due to loss of gall-bladder reflex, account for various conditions after cholecystectomy:—

1. Bile-ducts normally dilate after cholecystectomy. Sphincter resistance falls. Bile dribbles through continuously, as in retention with overflow.
2. Persistent contraction is probably cause of biliary colic after cholecystectomy for gall-stones: symptoms suggesting stone left in common duct. Often passes in short period.
3. 'Cystic dilatation of extrahepatic bile-ducts'. May be enormous. No obstruction or cause present.

Duodenal Contents.—Obtained by Lyon's method: passage of duodenal tube; aspiration of contents; injections of magnesium sulphate to stimulate contraction of gall-bladder. May be absence of bile.

'**White Bile**'.—Glands in common bile-duct secrete watery secretion, which dilutes bile. With complete obstruction, pressure rises so high that liver cannot secrete bile, and bile already present is absorbed by blood. Watery secretion continues and contents of dilated ducts become colourless.

Simple Enlargement of Gall-bladder.—Enlarges directly downwards from tip of 9th rib, or slightly inwards. Superficial, cucumber-shaped. Moves with respiration (unless adhesions). Movable laterally only. (Examine bimanually.)

'**Gall-bladder Spot**'.—Maximum tenderness is midway between umbilicus and tip of 9th rib.

Riedel's Lobe.—A tongue-like projection from lower edge of liver, usually following previous gall-stones or cholecystitis, and often covering diseased or enlarged gall-bladder.

Dilatation of Ducts above Obstructions.—Two forms: (a) Cylindrical; (b) Saccular. Rare, but may be enormous, simulating, and diagnosed as, various cysts.

Estimation of Fat in Faeces.—With stones in common duct, fatty acids exceed neutral fat. With carcinoma of pancreas, neutral fat exceeds fatty acids. (See p. 539.)

TREATMENT.

Attack of Biliary Colic.—Inject morph. sulph. gr. $\frac{1}{4}$ to $\frac{1}{2}$. Repeat if necessary. *Note*: morphia increases spasm of sphincter of Oddi and only relieves pain by dulling higher centres; hence need for large dose, and frequent failure. Inhalation of amyl nitrite: rapid but transient. Glyceryl trinitrate, gr. 1/100, placed under tongue: slower but more lasting. Atropine has no effect.

Bed until tenderness subsides.

Medical Treatment of Gall-stones.—Only as preparatory for operation, or when operation is contra-indicated.

DRUGS.—Mag. sulph. 3j or 3ij every morning. Hexamine, gr. 20 to 60, with alkalis, at night. To stimulate contraction of and disinfect gall-bladder.

REGULAR LIFE AND EXERCISE; AVOID CHILL AND FATIGUE.

BOWELS.—Daily action. Commence with a few rectal washes.

DIET.—Ordinary simple mixed diet: moderate quantity: reduce fats and substances rich in cholesterol, especially eggs.

FLUIDS.—Give freely: especially mineral waters, e.g., Vichy.

Surgical Treatment.—Not contra-indicated, in general, by cardiac symptoms, which often improve. For Complications of Cholecystectomy, see p. 526.

VIII. CIRRHOSES OF THE LIVER.

Conditions characterized by increase of the fibrous tissue of the liver. Lesions found at autopsy are end-results, and little is known of the earlier pathology and etiology.

Provisional Classification.—

1. **PORTAL CIRRHOSIS.**—*Synonyms*: Laennec's Cirrhosis. Multilobular Cirrhosis. Alcoholic Cirrhosis.

Etiological factor conveyed by blood-stream. Liver cells thus suffer primarily—i.e., parenchymatous injury followed by 'regeneration'. Fibrous tissue principally multilobular.

2. **BILIARY CIRRHOSIS.**—*Synonym*: Unilobular Cirrhosis.

Etiological factor conveyed by bile-ducts. Portal ducts suffer primarily—i.e., cholangitis. Fibrous tissue principally unilobular.

Two groups:—

a. **INFECTIVE CHOLANGITIS.**—*Synonym*: Hanot's Hyper-trophic Biliary Cirrhosis. Liver large.

b. **OBSTRUCTIVE CHOLANGITIS.**—*Synonym*: Charcot's Cirrhosis. Liver small.

Often included are:—

3. **CHRONIC PERIHEPATITIS.**

4. **SYPHILITIC HEPATITIS.**

Various conditions associated with cirrhosis: (a) Hæmochromatosis; (b) Banti's disease (multilobular); (c) Wilson's disease. Also Egyptian splenomegaly.

Cirrhosis of the Liver—*continued.*

ALCOHOLIC OR PORTAL CIRRHOSIS.

(*Multilobular Cirrhosis.*)

A chronic degeneration of the liver due to the prolonged ingestion of alcohol, characterized pathologically by increased interlobular fibrous tissue and degeneration of liver cells, and clinically by obstruction to the portal circulation.

Note.—Certain disputed theories are referred to at end of section.

Etiology.—

AGE.—Commonest, 40 to 50 years.

SEX.—Males 2 to 1 female.

ALCOHOL.—Almost invariable antecedent of portal cirrhosis.

Morbid Anatomy.—Two forms: (1) Atrophic cirrhosis; (2) Fatty cirrhotic liver; especially in beer drinkers. The essential changes in the liver are: (a) Increase of interlobular fibrous tissue; (b) Degeneration of liver cells—*viz.*, *hepatitis*.

1. ATROPHIC CIRRHOSIS OF LIVER.—

SIZE.—Usually small, sometimes markedly.

SHAPE.—Deformed. Capsule thickened.

SURFACE.—Irregular, with protruding 'hobnails', of size of pea upwards. Firm, cuts with resistance.

ON SECTION.—Pale. Yellowish areas surrounded by translucent strands of fibrous tissue, continuous with depressions on surface, and spreading from portal canals.

HISTOLOGY.—(1) Strands of fibrous tissue, mainly multilobular (enclosing several lobules): but varies, and in places, or when advanced, may be unilobular and intercellular.

(2) Liver cells degenerating, especially near periphery of lobule (i.e., in portal spheres), with invasion of fibrous tissue; some fat in cells. Often signs of 'regeneration'.

PORTAL VEIN and main liver branches thickened. Hepatic arteries dilated.

2. FATTY CIRRHOTIC LIVER.—

SIZE.—Enlarged.

SURFACE.—Smooth or slightly granular. Firm, cuts with resistance. Pale, and otherwise resembles 'fatty liver'.

HISTOLOGY.—Fatty degeneration and infiltration of liver cells marked. Other changes as in atrophic form.

OTHER CONDITIONS.—

PERITONEUM.—Surface opaque, often thickened. Ascites common.

STOMACH AND SMALL INTESTINES.—Chronic catarrh due to (a) alcohol, (b) portal congestion.

VEINS OF ŒSOPHAGUS AND GASTRIC CARDIA.—Varicose.

SPLEEN.—Enlarged.

TUBERCULOSIS.—Very common: pulmonary, pleuritic, or peritoneal.

Lungs compressed, if much ascites. Arteriosclerosis, myocarditis, fibrosis of kidneys common (probably alcoholism).

Collateral Circulation.—Principal veins involved:—

1. **ACCESSORY PORTAL SYSTEM OF SAPPEY.**—(i) Veins in round ligament connecting at umbilicus with epigastric and mammary veins: may form 'caput Medusæ'. (ii) Veins through suspensory ligaments, diaphragm, diaphragmatic veins, and vena azygos to superior vena cava.
2. **ŒSOPHAGEAL AND GASTRIC VEINS.**—Large varices at end of Œsophagus and cardia.
3. **RETROPERITONEAL VEINS**, connecting portal and inferior vena cava branches. Also 'veins of Retzius' forming sub-peritoneal anastomosis of these systems.
4. **INFERIOR MESENTERIC AND HÆMORRHOIDAL VEINS.**—Probably little influence: hæmorrhoids not markedly frequent.

Symptoms.—*May be latent* for years with advanced cirrhosis, if collateral circulation effective: duration longest in fatty cirrhotic liver: otherwise two forms are identical, except greater size and tenderness of liver in fatty type.

Common first complaints are: (1) Dyspepsia; (2) Hæmatemesis; (3) Slight jaundice; (4) Ascites and abdominal swelling.

Symptoms are *obstructive*, due to portal congestion, and *toxic*, due to destruction of liver cells.

CHARACTERISTIC SYMPTOMS.—

GASTRO-INTESTINAL CATARRH.—(Venous congestion and alcoholism.) (1) Anorexia, nausea and vomiting, especially morning; (2) Tongue furred, breath foul; (3) Constipation, and irregular bowels.

HÆMATEMESIS.—(Œsophageal varices.) Often early, very profuse, recurrent. Severe collapse and fatalities very rare.

OTHER HÆMORRHAGES.—Epistaxis, melæna common.

SLIGHT JAUNDICE.—Often absent. Definite jaundice rare.

PHYSICAL SIGNS.—

'HEPATIC FACIES'.—Dry, sallow, icteric skin: conjunctivæ watery; venules on nose and cheeks. Patient thin. Appearance often distinctive in late stages.

LIVER.—Often enlarged and tender: generally palpable, even if small. Hard edge, rough surface. A large fatty cirrhotic liver may diminish rapidly under treatment.

SPLEEN.—Usually palpable.

VENULES AT COSTAL MARGIN.

COLLATERAL CIRCULATION.—*See above.*

BLOOD-PRESSURE usually low. **HEART** often dilated.

ASCITES.—Common in late stages. Distended abdomen contrasts with wasting elsewhere. Fluid usually clear: rarely pseudo-chylous and very rarely hæmorrhagic.

TEMPERATURE.—Fever rarely entirely absent. If marked, suggests tuberculosis.

Alcoholic or Portal Cirrhosis—Symptoms, continued.

ANÆMIA.—Usually microcytic. (Megalocytic rarely recorded: probably storage failure of hæmopoietic factor.)

URINE.—Often reduced. Albumin common.

VARIOUS LATE CONDITIONS.—*Nævi*: spider angiomas, face, neck, back. *Edema* of feet: general anasarca rare. Various effects of ascites.

VAN DEN BERGH'S REACTION.—Varies.

TOXIC SYMPTOMS.—Delirium, coma, or a condition of cholæmia may develop at any time, but usually in late stages.

Complications.—*Delirium tremens*. *Ascites*. *Tuberculosis*, very common: cause of death in 15 to 25 per cent. *Pneumonia*. *Cholæmia*. *Chronic nephritis*. *Carcinoma*. *Thrombosis of portal vein* (rare).

Diagnosis.—In early stages, suggested by alcoholic history, gastritis, and enlarged liver. *Diagnosis definite* with 'hepatic facies', hæmatemesis, physical signs in liver and spleen, and ascites. Tests for liver function are usually normal. Difficulties may arise from:—

ENLARGED LIVER IN ABSENCE OF ASCITES.—(1) Passive congestion; (2) Fatty liver; (3) Malaria; (4) Leukæmia and splenic anæmia; (5) Syphilis; (6) Amyloid liver; (7) Biliary cirrhosis.

HÆMATEMESIS.—(1) Gastric and duodenal ulcer; (2) Carcinoma.

ASCITES.—(1) Tuberculous peritonitis; (2) Abdominal neoplasm; (3) Chronic peritonitis; (4) Portal thrombosis (very rare).

Prognosis.—Early stage is a hepatitis: if strictly teetotal may 'recover' even after liver enlarged. Subsequently, prognosis bad. Death usually 3 years from onset of symptoms: occasionally 8 to 10 years with good collateral circulation. Rarely, with teetotalism, apparent recovery. When *ascites* occurs, very bad: this is almost a terminal event.

Treatment.—(Syphilis should be excluded by a Wassermann test.)

EARLY STAGES.—A regular and moderate life. Moderate diet, plentiful fluid, regular bowels (saline aperient); *no alcohol*.

GASTRIC CATARRH.—Bismuth, and treatment as in gastritis.

HÆMATEMESIS.—(Often beneficial. Treat only when profuse.) Inject morphia.

ASCITES.—Treatment mainly to relieve discomfort. Great restriction of fluids inadvisable.

PARACENTESIS.—If volume of fluid affects heart, lungs, or comfort.

Notes on Certain Theories, etc.—

PATHOGENESIS OF THE LIVER CHANGES.—A causal toxin arriving in portal blood causes degeneration of liver cells; for a time 'regeneration' occurs. The fibrous tissue increases secondarily, as a 'replacement fibrosis'; later, contracting, it causes

atrophy of liver cells, compression of portal branches, and hence 'portal obstruction'. Against this theory is fact that cirrhosis is in excess of liver degeneration at any stage. Probably toxin affects both tissues simultaneously. (For 'Regeneration' and 'Newly-formed Bile-ducts', see ACUTE YELLOW ATROPHY, p. 506.)

ACTION OF ALCOHOL.—Theories: (1) Direct poison on liver cells. Cannot be produced in animals: an accessory factor may be necessary. (2) Produces gastro-intestinal catarrh, whence 'autotoxins' are absorbed. (3) Due to 'higher alcohols' and not to C_2H_5OH . All unproved.

CAUSES OTHER THAN ALCOHOL.—Typical condition occurs in teetotallers—e.g., in Brahmins. Etiology uncertain. Possibly related to 'toxic jaundice' (see p. 504 and SUBACUTE YELLOW ATROPHY, p. 508).

COLLATERAL CIRCULATION.—Good effect: relief of portal circulation. Bad effects: (1) Hæmorrhage from varicose; (2) Much blood escapes 'detoxifying' action of liver.

SPLENIC ENLARGEMENT.—Theories of origin: (1) From congestion: probable cause; supported by rapid enlargement in portal thrombosis; opposed by small spleen in chronic heart lesions (liver acts here as buffer). (2) From toxins causing the cirrhosis, or escaping liver in collateral circulation.

· HYPERTROPHIC BILIARY CIRRHOSIS.

(*Hanot's Disease.*)

A chronic condition of unknown origin, characterized pathologically by unilobular fibrosis of the liver, and clinically by jaundice, enlarged liver and spleen, and absence of ascites.

Note.—This description is given according to tradition. The existence of the disease as a constant entity may be doubted, but it may occur very rarely as the result of an *infective cholangitis*. It is frequently diagnosed erroneously in quite different conditions.

Etiology.—

AGE.—Young adults.

SEX.—Males; very rare in females.

CAUSE.—Unknown; alcohol is not a factor; theory of an infection is based on febrile attacks with leucocytosis.

Morbid Anatomy.—

LIVER.—Enlarged markedly. Heavy. Shape normal. Surface smooth. Colour, *dark green* (late stage). Very hard. On section, surface greenish yellow, strands of fibrous tissue visible.

Histology: (1) Fibrous tissue increased, *especially unilobular*. (2) Cholangitis: proliferation and desquamation of epithelium in smaller ducts, whence obstruction and blockage with bile thrombi. (3) Numerous 'newly-formed bile-ducts' present (liver 'regeneration'). Degeneration of liver cells not extreme.

SPLEEN.—Enlarged: fibrosis and atrophy. Weight: 24 to 36 oz. Gall-bladder, bile-ducts, portal vein and tributaries, normal. No gastro-intestinal catarrh. No ascites.

Hypertrophic Biliary Cirrhosis, continued.

Symptoms.—Young males. No alcoholic history. Very chronic; four to ten years.

ONSET.—Insidious. *Progressive weakness* and malaise. Abdomen swells.

RECURRENT ATTACKS.—Pain over liver, pyrexia, leucocytosis; often nausea, vomiting, and deeper jaundice. Duration, days to weeks.

JAUNDICE.—Tinge slight at onset, progresses; often finally dark.

LIVER AND SPLEEN.—Greatly enlarged. Edge firm.

Usual symptoms of jaundice, except stools dark. Moderate anæmia.

In later stages may be: *skin very dark*; hæmorrhage from gums, etc. (icteric origin)—hæmatemesis rare. *Absent*: ascites, signs of portal obstruction. Dyspepsia slight or absent.

Termination.—Progressive weakness; always fatal. Termination: intercurrent diseases, occasionally 'cholæmia', or icterus gravis during febrile attack.

Treatment.—Symptomatic.

OBSTRUCTIVE BILIARY CIRRHOSIS.

(*Charcot's Cirrhosis.*)

Is result of ascending cholangitis due to obstruction of bile-ducts from: chronic obstruction by gall-stone, stenosis following operation, chronic pancreatitis, carcinoma of head of pancreas. Very rare.

Morbid Anatomy.—Liver contracted and irregular. Dark green. Fibrosis, multilobular or unilobular.

Clinical Features.—Depend on cause. Progressive jaundice. Operation may cure, if cause removable.

CHRONIC PERIHEPATITIS.

(*Sugar-iced Liver. Zuckergussleber.*)

Morbid Anatomy.—(1) Capsule enormously thickened; (2) Liver contracted, but little or no interstitial cirrhosis; (3) Varying degrees of chronic perisplenitis; (4) Chronic proliferative peritonitis; and (5) Chronic interstitial nephritis.

Clinical Features.—(1) Recurrent ascites; (2) No jaundice; (3) Chronic nephritis. All degrees to typical 'chronic proliferative peritonitis' (see p. 553).

SYPHILITIC HEPATITIS.

See SYPHILIS OF THE LIVER, p. 231.

IX. ABSCESS OF THE LIVER.

Etiology.—Secondary to conditions outside liver. Two groups:—

1. **Amœbic Hepatitis and Abscess (Tropical Abscess).**

2. **Multiple or Pyæmic Abscesses.**—Path of infection:—

a. **SUPPURATIVE PYLEPHLEBITIS.**—Through portal vein. Primary focus: appendix; less commonly, other regions in portal area, especially sepsis of hæmorrhoids and rectum.

b. SUPPURATIVE CHOLANGITIS.—Through the bile-passages. Arising from : gall-stones (*see* p. 511).

c. GENERAL SEPTICÆMIA OR PYÆMIA.—Through general circulation.

Occasional causes : trauma of liver, hydatid cysts.

In bacillary dysentery and similar intestinal infections, abscess of the liver occurs very rarely, and is not always fatal.

1. AMŒBIC HEPATITIS AND AMŒBIC ABSCESS.

Caused by *Entamœba histolytica*. Occurs in 2 per cent of cases of amœbic dysentery.

Special Points.—

PREVIOUS DYSENTERY.—History in high percentage of cases.

May have been mild. Occasionally no record : in some of these sigmoidoscopy reveals small ulcers with cysts present.

INTERVAL SINCE DYSENTERY.—May be acute within few weeks. May be 5 to 10 years or longer.

AMŒBIC HEPATITIS.—First stage of liver involvement. If treated, does not progress to abscess. Pathology unknown : probably diffuse, as lævulose test shows insufficiency. Amœbic abscess thus occurs only if already formed or hepatitis untreated. No definite signs distinguish hepatitis from abscess : recognition of abscess by (1) tumour present, (2) lack of response to emetine in 7 to 10 days.

CHRONIC ALCOHOLISM.—Predisposing factor.

MODE OF ONSET.—May be : (1) Acute or subacute : symptoms develop rapidly : may be shortly after dysentery. (2) Chronic : slow development.

Acute Amœbic Hepatitis and Abscess.

Symptoms.—Progress rapidly.

1. **PAIN.**—(i) Over liver ; (ii) Back and *right shoulder*.

2. **LIVER ENLARGED AND TENDER.**—Abdominal muscles rigid. If abscess, dullness, usually increased upwards in mid-axillary line, from common position of abscess (top of right lobe) ; if in left lobe, tender tumour in epigastrium.

3. **ICTEROID TINT.**—Sometimes absent. Rarely deep jaundice.

4. **CONSTITUTIONAL SYMPTOMS** (less marked in chronic forms).—(i) *Fever* : irregular, rising to 103°. (ii) *Rigors*. (iii) *Profuse sweats*. (iv) From septic absorption : muddy complexion, wasting, anorexia, furred tongue.

5. **PULMONARY SYMPTOMS AT RIGHT BASE.**—Cough and pleurisy. (Inflammation spreading through diaphragm. In later stages, and not invariable.)

RADIOGRAPHS.—Right dome of diaphragm may be raised and immobile : some opacity at right base.

Acute Amœbic Hepatitis and Abscess—Symptoms, continued.

CHRONIC FORMS.—Slow development. Symptoms slighter.

LEUCOCYTOSIS.—10,000 to 25,000; mainly polynuclears. May be absent.

No ascites, nor enlargement of spleen.

Diagnosis.—Difficult in early stages. History of amœbiasis important. Examine stools for cysts, and X-ray chest. Diagnosis from :
(1) *Malaria*. Often simulated by recurrent pyrexia and rigors. Protozoa in blood, effect of quinine. (2) *Empyema*. (3) Gallstones (hepatic intermittent fever). (4) *Pylephlebitis*. (5) Suppurating hydatid cysts.

Amœbic Abscess.

Morbid Anatomy.—Commonly single, in right lobe and on diaphragmatic surface. Occasionally two or more present. Early abscess: contents gray yellow. Larger abscess: necrotic walls, contents reddish mass of blood and liver tissue. Old abscess has dense, fibrous walls.

Contents are sterile (in absence of secondary infection), are not purulent, and consist of detritus. Amœbæ only present in recent abscess: in old abscesses only found in walls.

Perforation.—Occurs into:—

1. **LUNGS.**—Most common. Either direct into lung or via pleura. Symptoms: (i) Cough; (ii) Signs at right base; (iii) 'Anchovy sauce' sputum when lung perforated—contains amœbæ, liver tissue, pus scanty. Prognosis: mortality 25 per cent, recovery often slow (if without emetine treatment).
2. **OTHER SITES.**—Externally. Stomach. Peritoneum (local or general infection).

Chronic Amœbic Hepatitis.

Presumed to be present in those exposed to infection, exhibiting 'liverish' attacks: liver may be tender and palpable. Responds to emetine.

Treatment.

Emetine Hydrochloride.—Hypodermic or intramuscular injection: gr. j daily for 12 injections (*see* p. 94). Rapid improvement. Course should be repeated. *Yatren* may be given also (*see* p. 95).

Liver Abscess.—If no improvement in hepatitis in 7 to 10 days, abscess present. May become absorbed under further treatment. *aspiration* will shorten course. *Operation* only for epigastric abscess.

Note.—*Aspiration* in stage of diffuse hepatitis involves risk of hæmorrhage.

Prognosis.—Good. Mortality low with modern treatment.

2. PYÆMIC ABSCESS.

Morbid Anatomy.—

LIVER.—Enlarged, surface smooth, yellow foci of pus often visible under capsule. On section, numerous foci of pus: (1) With suppurative pylephlebitis, foci are in branches of the portal vein. (2) With suppurative cholangitis, foci are in smaller bile-ducts, and gall-bladder and larger ducts are distended with pus.

SINGLE ABSCESS.—Numerous small foci may fuse.

Symptoms.—(1) Severe constitutional symptoms: pyrexia, sweats, rigors. In later stages and extreme forms, often apyrexia and dry skin. (2) Liver enlarged and tender. (3) Icteroid tint. Leucocytosis variable: very high, or often absent. Symptoms of causal condition often mask onset and development.

Diagnosis.—Suspected more easily than definitely diagnosed. Is always secondary to sepsis elsewhere.

Treatment.—Palliative.

X. NEW GROWTHS IN THE LIVER.

Secondary malignant tumours are common; all others very rare.

MALIGNANT TUMOURS.

Primary Malignant Growths.—Distinction from secondary tumours only by autopsy, after careful search for primary growth (often small, e.g., in rectum). Tend to greater rapidity of growth: jaundice and ascites less common, except type with cirrhosis.

A. CARCINOMA.—Varieties: (1) '*Massive carcinoma*'. Solitary tumour. (2) '*Nodular carcinoma*'. Multiple growths as in secondary forms. Foregoing are usually spheroidal-celled. (3) '*Carcinoma with cirrhosis*': probably carcinoma developing in a previously cirrhotic liver, compensatory hyperplasia of the liver cells (excessive 'regeneration') occurring and passing into carcinoma.

B. SARCOMA.—Extremely rare.

Growths corresponding to renal hypernephroma also occur.

Secondary Growths.—*Age*: commonest 40 to 60 years.

A. CARCINOMA.—Common. Liver very large. Nodules on surface, often 'umbilicated': on section grayish or hæmorrhagic: often numerous.

HISTOLOGY.—Character of primary growth, usually columnar-celled. Degenerations common.

SITE OF PRIMARY GROWTH.—(1) Stomach: in 25 per cent.

(2) Rectum and colon: also common: often small growth.

(3) Other sites in order of frequency: pancreas, bile-passages, uterus, œsophagus, breast, etc.

B. MELANOTIC SARCOMA.—Liver very large. Either: (1) Black nodules; or (2) General infiltration. Metastases present throughout body. Rapidly fatal. Melanuria occasionally.

Malignant Tumours of the Liver—Secondary Growths, continued.

SITE OF PRIMARY GROWTH.—(1) Pigmented mole. (2) In eye (often removed even years previously).
Other sarcomata extremely rare.

Characteristic Symptoms.—

1. LIVER.—*Progressive enlargement*. Discomfort, but often painless.
2. EMACIATION.—Anorexia and gastric troubles common.
3. JAUNDICE.—In 60 per cent: when occurring is permanent and progressive.

Physical Signs.—

LIVER.—(1) Enlarged. (2) Nodular: edge irregular. (3) Nodules often *umbilicated*. Spleen not enlarged.

ASCITES.—In 60 per cent.

NODULES AT UMBILICUS AND ALONG LINEA ALBA.—

Grow along falciform ligament. Important; not very common.

PYREXIA.—Usually present, about 100°. Spleen not enlarged.

OCCASIONALLY.—Symptoms of primary growth elsewhere in body. Pleurisy at right base, and cough. *Œdema of feet*, late. Superficial abdominal veins dilated (not round navel).

NOTES.—*Jaundice* usually from pressure of lymphatic glands in fissure, or of growth in head of pancreas. *Ascites* from pressure on portal vein, or often from peritonitis. *Enlargement of liver* absent in rare primary nodular type and 'carcinoma with cirrhosis': latter is clinically identical with cirrhotic liver.

Duration.—Three to twelve months.

Diagnosis.—Obvious with characteristic symptoms: (1) Progressively enlarging liver with nodules, often umbilicated; (2) Rapid cachexia; (3) Increasing jaundice, especially if with (4) Ascites.
Diagnosis from:—

1. ENLARGED CIRRHOTIC LIVER.—Enlargement not progressive or nodular, emaciation less, history of alcohol. Portal obstruction prominent.
2. FATTY AND AMYLOID LIVERS.—No jaundice or rapid enlargement, emaciation less. Gummata in amyloid liver may be nodular (Wassermann reaction positive).
3. GALL-STONES IN COMMON BILE-DUCT.—Jaundice and liver diminish from maximum after onset.
4. GUMMATA.—Signs of syphilis, and a positive Wassermann.

Other conditions:—

5. RIEDEL'S LOBE.—Previous gall-stones.
6. HYDATID CYSTS.—Nodules soft, no jaundice or cachexia.

Treatment.—Palliative.

BENIGN TUMOURS.

Rare. Of no clinical importance. *Angioma* or *nævus* most frequent: size of walnut.

CYSTS.

Parasitic.—Hydatid.

Non-Parasitic.—Single or multiple. Occur alone, or with:
(a) Congenital cystic kidneys; (b) Other congenital abnormalities.

XI. FATTY LIVER.

Two forms: (1) *Fatty infiltration*; (2) *Fatty degeneration*.

Infiltration is deposit of fat globules in otherwise normal liver-cells. In **degeneration**, in addition to fat, the cells are degenerated: the fat is said to be mainly deposited from elsewhere in the body. *The two types are often combined, but typical forms occur.*

Infiltration.—In obesity. Physiologically in pregnancy.

Degeneration.—Toxic causes: as in toxic jaundice (*see* p. 504). In advanced cachexia.

Morbid Anatomy.—Liver enlarged: on section pale, often leaves fat on knife. *Histology*: (a) Infiltration: fat mainly in periphery of lobule within normal cells. (b) Degeneration: fat mainly in central zone in granular degenerated cells.

Symptoms.—Indefinite. Those of causal condition. *Liver* enlarged, smooth, and painless. Never jaundice or ascites.

XII. AMYLOID LIVER.

(*Waxy or Lardaceous Liver.*)

Occurs as part of general amyloid disease in young adults with cachexia, usually from chronic suppuration.

Primary Causes.—

1. TUBERCULOSIS.—Especially: (a) Bones, frequent; (b) Lungs.
2. SYPHILIS.—Especially: (a) Bones; (b) Rectum. Suppuration not invariable.

Occasionally rickets, severe fevers, cancer.

Morbid Anatomy.—Liver large, solid, anæmic. On section, glistening surface ('cut bacon'). With iodine, stains dark brown, especially in central zone of lobule. *Histology*: Amyloid material deposited first in subendothelial layer of capillaries in central zone of lobule. Amyloid changes common in other organs: kidneys, spleen, intestines.

Symptoms.—Indefinite. *Liver* enlarged, edge round and smooth. Spleen often palpable. No ascites. In general amyloid disease: anæmia, wasting, also diarrhœa (if intestines affected). Albuminuria is common.

Diagnosis.—Enlarged liver, with etiological factors present.

Prognosis.—Very bad: progressive emaciation. No cure or treatment.

XIII. ABNORMALITIES OF THE LIVER.

Congenital Abnormalities.—(a) Transposition of viscera; (b) Forward tilting (simulates enlargement).

Acquired Abnormalities.—

'LACING' OR 'CORSET' LIVER.—A pressure atrophy followed by fibrosis. Usually a narrow transverse groove of fibrous tissue divides liver into two parts, lower portion almost reaching navel. Capsule often thickened, and impression of ribs obvious. Occurs also without cause.

'RIEDEL'S LOBE'.—A tongue-like projection following chronic cholecystitis, or gall-stones: often covers an enlarged gall-bladder.

MOVABLE LIVER.—Usually in visceroptosis, in females with pendulous abdomens. Also after recurrent ascites.

CHAPTER LXXXV.**DISEASES OF THE PANCREAS.****I. PANCREATIC INSUFFICIENCY.**

Two groups (independent):—

1. Internal Secretion Deficient.—*See* DIABETES.

2. External Secretion or Pancreatic Juice Deficient.—Pancreatic juice contains: (i) Trypsinogen, the zymogen of trypsin: protein ferment. Normally activated by enterokinase in intestinal juice. (ii) Lipase or steapsin: fat ferment. (iii) Diastase or amylpsin: starch ferment. Voluminous stools result from diminished absorption owing to deficient digestion. For pancreatic infantilism, *see* CÆLIAC DISEASE.

Tests of Pancreatic Insufficiency.—

1. LOEWI'S ADRENALIN MYDRIATIC REACTION.—Place on conjunctiva two drops of adrenalin 1-1000: repeat in 15 minutes: if pupil dilates, suggests deficiency of pancreatic secretion. Due to irritability of sympathetic nervous system.

2. EXTERNAL SECRETION.—Numerous tests exist: all unsatisfactory. Most definite results: (i) Steatorrhœa: increase of fat in fæces. (ii) Azotorrhœa: presence of striated muscle fibres. (iii) Diastase increases in urine: is absorbed by blood from pancreas and excreted into urine. '*Diastatic index*': normal 6 to 20 units (Wohlgemuth).

'Pancreatic Stools'.—Result from deficiency of ferments. Characteristics are: (1) Bulky; (2) Frothy; (3) Oily; (4) Light colour, mainly due to fat. Chemical alterations in the stools are:—

STEATORRHŒA.—Excess and abnormality of fat. *See below.*

AZOTORRHŒA.—Of protein in food, amount recoverable in fæces is normally about 5 per cent, but in pancreatic disease 30 to

40 per cent. Normal variations are considerable, and results are greatly influenced by: (a) Diarrhœa, which increases amount; (b) Constipation, which decreases amount owing to putrefaction. All tests to measure action of trypsin are complicated by the same factors, and are of little value.

Fat in Fæces.—Three factors influence this: (1) *Pancreatic secretion*, i.e., lipase. This splits neutral fat of food into glycerin and fatty acids, the latter partly combining with alkalis to form 'soaps'. The fatty acids and soaps (i.e., the 'split fat') can be absorbed, but not the neutral fat. (2) *Bile*. This aids absorption of 'split fat', but has no part in its formation from neutral fat. (3) *Intestinal absorption*—e.g., deficient in sprue, cœliac disease. Hence: (1) *If pancreatic secretion be deficient*, results are: (a) large amount of undigested fat, (b) abnormal relative percentage of neutral fat. (2) *If bile be deficient*, results are (a) large amount of undigested fat, (b) abnormal relative percentage of 'split fat'.

NOTE.—In diarrhœa, *fat-splitting bacilli* in intestine are numerous, and intestinal absorption is also reduced, result being a high amount of 'split fat'. This affects results in pancreatic deficiency, diarrhœa being usual: increases amount of 'split fat'.

NORMAL FAT IN DRIED FÆCES.—Total: 15 to 25 per cent. Neutral (unsplit): 1 to 2. Split: (a) Fatty acids: 9 to 13. (b) Soaps: 10 to 15.

FAT EXCRETION.

<i>Lesion</i>	<i>Total Fat (per cent of dried fæces)</i>	<i>Form of Fat in Excess</i>
Normal	15 to 25	Split
Pancreatic deficiency	50 to 80	Neutral
Deficiency of bile	60 to 70	Split
Cœliac disease	40 to 70	Split

II. PATHOLOGY OF ACUTE PANCREATIC LESIONS.

The Origin of Lesions of the Pancreas.—Destruction of the pancreatic tissue by the trypsin of its own secretion (i.e., auto-lysis) is probably the basis of many pancreatic lesions. Bacterial infection is also a factor.

Pathogenesis of 'hæmorrhagic necrosis of the pancreas'.—Probable sequence:—

1. Pancreatic secretion infiltrates tissues of pancreas, owing to obstruction of its exit.

Pathology of Acute Pancreatic Lesions—Pathogenesis, *continued*.

2. Necrosis of the pancreatic cells and *blood-vessels* results. This autolysis is due to trypsin, and is not 'fat necrosis'.
3. Hæmorrhage thus occurs into, and then extends beyond, the gland, with consequent escape of secretion, and 'fat necrosis' of surrounding tissues (*see below*).

Note.—Pancreatic juice is innocuous until activated : this can be effected by bile, intestinal contents, by kinase present in injured tissues of pancreas, and by action of bacteria.

OBSTRUCTION TO THE PANCREATIC SECRETION.—May arise from : (1) *Action of gall-stones*, usual cause. (2) *Gastric juice and duodenal contents* entering the gland. This possibly occurs from injury to duodenal papilla by : (a) Gall-stones ; (b) Vomiting and gastritis ; (c) Abnormal Oddi's sphincter. Other causes may be : (3) Cancer. (4) Trauma. (5) Pancreatic calculi. (6) Parasites. (7) Cirrhosis of liver and pancreas.

[The pancreas has two ducts : (1) *Wirsung's* main duct, joins the common bile-duct in ampulla of Vater ; (2) *Santorini's* accessory duct, independent opening into duodenum.

Note.—(i) In 90 per cent the two ducts connect and hence a partial alternative path exists ; (ii) In 10 per cent of all cases Santorini's is the main duct.]

ACTION OF GALL-STONES ON THE PANCREAS.—Methods by which gall-stones affect the pancreas.

1. *Stone in the ampulla of Vater*.—

- i. A small stone may obstruct the exit without occluding either the common bile or Wirsung's duct. Hence, *bile passes up Wirsung's duct*, and together with the pancreatic secretion causes *hæmorrhagic necrosis* and its sequelæ. Undoubted origin of most acute pancreatic lesions. Rarity is due to : (a) Stone in ampulla blocks one or both ducts in at least 70 per cent ; (b) Anatomy of ducts.

- ii. When Wirsung's duct is blocked, *chronic pancreatitis* results from retention of secretion.

2. *Passage of a stone may enlarge duodenal papilla*.—Thus *duodenal contents* can enter Wirsung's duct, causing *hæmorrhagic necrosis* and sequelæ.

Note.—Duodenal contents cannot enter normal papilla owing to Oddi's sphincter. Both bile and gastric juice (or duodenal contents) experimentally injected into Wirsung's duct produce lesions identical with hæmorrhagic necrosis and its sequelæ.

3. *Inflammation spreads to pancreas from common bile-duct*, due to passage of a calculus, causing *chronic pancreatitis* (this swelling may itself compress duct later, and prolong jaundice).

Fat Necrosis.—

MODE OF PRODUCTION (*see above*).—Pancreatic juice, liberated by necrosis and hæmorrhage, meets fat of its own and other tissues near, and by its lipase (fat-splitting ferment) produces *fat necrosis*.

Thus presence of fat necrosis is *proof of hæmorrhagic necrosis of pancreas*.

CHEMICAL CHANGE.—The fat is split into glycerin, which is absorbed, and fatty acids, which are deposited as *opaque needle-like crystals* often combined with calcium.

PATHOLOGICAL CHARACTERS.—*Sites*: Interlobular pancreatic tissue, mesentery, omentum, and abdominal fat, especially near pancreas. *Appearance of foci*: (a) Size of pin's head (may be larger); (b) Opaque white; (c) Sharply defined, suggestive of military tubercles but not raised. May appear within three hours of lesion. *Pancreas*: Lobules separated by dead-white areas (see ACUTE PANCREATITIS).

III. ACUTE PANCREATITIS.

(*Hæmorrhagic Necrosis of the Pancreas*.)

'Hæmorrhagic necrosis of the pancreas' (Opie) is the more correct term, since steps are: (1) Tryptic necrosis; (2) Hæmorrhage; (3) Inflammation, which is absent at onset.

Clinical Groups.—Various conditions, usually known as follows, are recognizable, but—of varying severity—are of similar etiology:

- (1) *Pancreatic hæmorrhage or apoplexy*, fatal in a few hours: rare.
- (2) *Acute hæmorrhagic pancreatitis*, fatal in two to five days: occasional recovery.
- (3) *Gangrenous pancreatitis*, subacute: fatal in weeks or months.
- (4) *Acute suppurative pancreatitis* occurs when bacteria are present. Certain *pancreatic and peripancreatic cysts* are sequelæ of the acute lesions.

1. PANCREATIC HÆMORRHAGE.

Of medico-legal importance as a cause of rapid death in those apparently in good health.

Pathologically to be regarded as a severe form of hæmorrhagic necrosis of the pancreas.

2. ACUTE HÆMORRHAGIC NECROSIS.

Usually in adult males.

Cause.—Obstruction to pancreatic secretion (see PATHOLOGY OF ACUTE PANCREATIC LESIONS), or trauma. or bacterial infections.

Morbid Anatomy.—

PANCREAS.—Swollen. On section, mottled appearance: infiltration with altered blood. *Histology*: Necrosis of parenchymatous cells of blood-vessels and interstitial tissue, much blood; inflammatory changes at margin of necrosis.

HÆMORRHAGE.—In tissues of and around pancreas: often in lesser sac.

FAT NECROSIS.—See above.

GALL-STONE.—May be present in gall-bladder or ampulla of Vater.

Acute Hæmorrhagic Necrosis, *continued*.

Symptoms.—Onset often preceded by dyspepsia and gastric pain. Previous biliary colic not infrequent. Chief features are :—

SUDDEN ONSET.

PAIN.—Severe and paroxysmal in upper abdomen.

SHOCK AND COLLAPSE.—Very rapid onset. Cold skin.

VOMITING.—Early, copious, and bile-stained. Rarely fæcal.

ABDOMEN DISTENDED.—Above umbilicus. Tenderness is extreme, but rigidity often slight. Tumour rare. Constipation.

TEMPERATURE.—Low at onset : may rise, or remain subnormal.

DIASTATIC INDEX.—Over 100, usually over 200 units.

Loewi's test varies.

Leucocytosis usual. Jaundice occasionally. Glycosuria very rare.

Death on second to fourth day, or earlier ('pancreatic apoplexy').

Occasional recovery.

Diagnosis.—Difficult. Especially from : (1) *Peritonitis*, e.g., perforated peptic ulcer ; (2) *Acute intestinal obstruction* ; (3) *Gall-stones*.

Treatment.—Laparotomy. Search for gall-stone, and remove if present. Otherwise operation as rapid as possible.

3. GANGRENOUS PANCREATITIS.

Etiology.—A later stage of last condition, hence develops in forms with *less acute onset*. Very rare. In acute hæmorrhagic pancreatitis surviving one week, pancreas is found dry and reddish-black ; after (about) two weeks is black and friable ; later, an offensive black fluid in lesser sac, condition constituting 'gangrenous pancreatitis'. General peritonitis rare owing to adhesions.

Symptoms.—As in last condition, but diminishing after fourth day. Subsequently : (1) *Fever and signs of sepsis*. (2) *Tumour* above umbilicus, stomach above and colon below, 'extending towards spleen, due to fluid in lesser sac. Other symptoms may be : Epigastric pain and tenderness, vomiting, leucocytosis, diarrhœa common, jaundice occasionally. Glycosuria very rare.

Treatment.—Evacuate fluid. Recovery extremely rare.

4. SUPPURATIVE PANCREATITIS.

(*Abscess of Pancreas.*)

Etiology.—As above. Suppuration in addition. Acute hæmorrhagic pancreatitis may precede abscess.

Abscess may be single or multiple.

Symptoms.—Usually indefinite. Often previous attacks of pain and vomiting. Principal symptoms : (1) *Fever and sepsis* ; (2) *Epigastric tumour* (often absent). Rare : jaundice and glycosuria.

Sequelæ.—May be : (a) *Peripancreatic abscess* ; (b) *Perforation* of abscess into stomach, duodenum, or peritoneal cavity ; (c) *Thrombosis* of portal vein.

Treatment.—Operation. Recovery may occur.

5. SUBACUTE PANCREATITIS.

A form occurs in mumps, characterized by pain in upper abdomen : prognosis always good. Slight injuries or hæmorrhage of pancreas may produce attacks of epigastric pain over prolonged periods.

IV. CHRONIC PANCREATITIS.

Chronic interstitial pancreatitis occurs in two histological types, which differ also in clinical manifestations, and probably in etiology.

1. Chronic Interlobular Pancreatitis.—

ETIOLOGY.—Cause arises from ducts.

1. Partial or complete occlusion of Wirsung's duct (usual origin) from : (a) Gall-stones in ampulla ; (b) Carcinoma ; (c) Pancreatic calculi (probably secondary to catarrh of ducts).
2. Inflammation of bile-ducts, due to gall-stones, spreads to surrounding pancreas. (Pancreas normally surrounds bile-duct in 60 per cent.)
3. Inflammation ascends duct from gut.

MORBID ANATOMY.—Pancreas hard. *Histology* : Strands of fibrous tissue between lobules ; in early stages, cells of lobules little affected, but later degenerate ; *islands of Langerhans persist until fibrosis extreme*. Pancreatic calculi may be present. Also gall-stones and cirrhosis of liver.

SYMPTOMS.—Indefinite : often latent. Pancreatic insufficiency rare. If pancreas surrounds bile-duct : painless jaundice, gall-bladder enlarged (unless previous cholecystitis) ; otherwise jaundice may be absent. Pain often absent, but may be recurrent attacks, even with paroxysms resembling biliary colic, but pain is situated along left costal margin and posteriorly to left of spine. Glycosuria very rare.

DIAGNOSIS.—Consider if features present are chronic jaundice, no pain, gall-bladder enlarged.

TREATMENT.—Cholecystenterostomy if chronic jaundice.

2. Chronic Interacinar Pancreatitis.—See DIABETES, p. 337.

V. PANCREATIC CYSTS.

Decision whether origin of a cyst is from pancreas or other structure is often difficult (*see* MESENTERIC CYSTS, p. 556).

Morbid Anatomy.—

RETENTION CYSTS.—*True cysts*. Due to obstruction of main ducts : also from chronic interstitial pancreatitis blocking small ducts, or sequel of acute pancreatitis. Rarely large.

PROLIFERATION OF EPITHELIUM AND CYSTO-ADENOMA.
—Multilocular. Very rare.

PSEUDOCYSTS.—Hæmorrhage and fluid in lesser sac. Etiology : trauma, acute hæmorrhagic pancreatitis.

HYDATID CYSTS.—Extremely rare.

Pancreatic Cysts, continued.**Symptoms.—**

TUMOUR.—Round tumour above umbilicus, median or slightly to left. Smooth, spherical, fluctuates, often movable, rarely moves with respiration. *Relation to neighbouring organs* may be: (1) Stomach above and colon below, most common (well exhibited by inflating colon); (2) More rarely, appears above or behind stomach, and occasionally below colon. Often no symptoms until very large. May exist for years.

Severe attacks of colic in epigastrium may occur; tends to radiate to left side and scapula; may be vomiting. Occasionally jaundice. Signs of pancreatic insufficiency very rare.

Contents of Cyst.—Reddish fluid. Alkaline. Contains blood and cholesterol. Also contains ferments: most important in diagnosis is proteolytic ferment, since fat and starch-splitting ferments occur in other exudates; but proteolytic ferment may be absent, owing to antitryptic action of blood; also it is occasionally present elsewhere.

Diagnosis.—Chief features are character of cyst, and situation and relation to other organs. Diagnosis from mesenteric and retro-peritoneal cysts usually impossible. From hydatid cysts, *hydro-nephrosis*, and *ovarian cyst*, by above features.

Treatment.—Preferably by partial removal and drainage: obstinate pancreatic fistula, and digestion at edges of wound, often troublesome. May recur. Total removal should never be attempted, owing to risk of uncontrollable hæmorrhage. Aspiration is dangerous, and re-accumulation usual.

VI. TUMOURS OF THE PANCREAS.

Varieties.—*Carcinoma* is the common tumour, usually of head. Sarcoma, adenoma very rare. Pancreas is frequently invaded by growths of stomach, bile-ducts, etc., and site of primary growth often uncertain.

Carcinoma of Head of Pancreas.

Symptoms.—Pressure symptoms common: (a) Bile-duct; (b) Pancreatic duct, causing retention cysts.

EPIGASTRIC PAIN.—Often severe paroxysms. (Possibly from coeliac ganglion.) Bilateral or maximum on left.

JAUNDICE.—Intense, permanent, and progressive. (May be absent if pancreas does not surround the gall-bladder.)

GALL-BLADDER ENLARGED.—Not always palpable.

RAPID EMACIATION.

NAUSEA AND VOMITING common.

Growth is rarely palpable.

Very rare are: glycosuria; fatty stools.

Diagnosis.—*From gall-stones* by: (1) Rapid emaciation; (2) Gall-bladder usually enlarged (Courvoisier's Law, *see* p. 525); (3) Jaundice appears gradually, is progressive, and does not intermit. *From carcinoma of bile-ducts, duodenum, stomach, or liver* when compressing the common bile-duct, is usually indistinguishable.

Treatment.—Palliative. Cholecystenterostomy may relieve jaundice.

Carcinoma of Body or Tail of Pancreas.

Clinical Features.—Tumour may be palpable with emaciation. No jaundice. May be attacks of pain.

VII. PANCREATIC CALCULI.

Etiology.—Probably secondary to inflammation of ducts (*see* CHRONIC INTERLOBULAR PANCREATITIS). Are formed in the ducts. No relation to carcinoma.

Characters.—Small. Nearly always multiple. Opaque white. *Composition*: inorganic salts, viz., calcium carbonate or phosphate. *Opaque to X rays*.

Morbid Anatomy.—Behind stone ducts are dilated, and chronic interstitial pancreatitis is usually extreme: often almost complete disorganization of pancreas. Rarely suppuration and abscess formation occur.

Symptoms.—Indefinite. May be severe attacks of epigastric colic, often with vomiting and recurrent rigors; pain tends to radiate to left side and scapula. May be jaundice. Rarely in chronic severe cases with pancreatic insufficiency: hyperglycæmia and glycosuria, wasting, fatty stools.

CHAPTER LXXXVI.

DISEASES OF THE PERITONEUM.

I. ACUTE GENERAL PERITONITIS.

Etiology.—May be primary or secondary.

1. **PRIMARY PERITONITIS.**—(i) *Idiopathic*: following cold or exposure: no other evident cause. Rare. Usually pneumococcal. (ii) *Terminal*: in chronic nephritis, arteriosclerosis, etc.

2. **SECONDARY PERITONITIS.**—Due to: (i) *Perforation*: usual origin, especially of appendix, stomach, and duodenum; in enteric, dysentery, and ulcerations of the intestine. (ii) *Extension of inflammation*: from cancer, acute inflammation of neighbouring organs, stomach, intestines, pelvic viscera (e.g., puerperal peritonitis). (iii) *Infection by the blood-stream* in septicæmia and pyæmia.

Acute General Peritonitis, *continued.*

Morbid Anatomy.—

INTESTINAL COILS.—Distended, owing to paralysis and accumulation of gas: adherent through lymph and exudation in various degrees.

PERITONEUM.—Red, injected, and early loss of lustre. Exudation forms.

EXUDATION.—Amount and character varies: (1) Fibrinous, much lymph with little serum. (2) Sero-fibrinous, much serous fluid, lymph on coils. (3) Purulent: pus may be thin, or opaque and creamy. Occasionally: (4) No exudation, but peritoneum widely injected; severe type, usually streptococcal and puerperal. (5) Gas present (gas-forming anaerobes) in perforation of viscus. (6) Hæmorrhagic, especially cancer.

Bacteriology.—

Most frequently: (1) *B. coli communis* and bacilli of colon group in numerous varieties, including *B. pyocyaneus*, Friedländer's bacillus; (2) Streptococcus, often associated with *B. coli*; (3) Pneumococcus; (4) Staphylococcus. Other bacteria may be: Anaerobic bacilli. Gonococcus. Enteric group. Very rarely: *B. influenza* and others.

Symptoms.—

ONSET.—(1) *Abdominal pain*: intense, often sudden, increased by pressure, and by all movements; at complete rest may be slight; widespread, or referred to umbilicus. (2) *Abdominal tenderness*: often extreme. (3) *Abdominal rigidity*. (4) Vomiting. (5) *Decubitus*: lies on back, knees drawn up, shoulders raised, arms above head. *Restlessness*. *Respiration* shallow and costal. *Temperature usually subnormal*. In septic cases, chills and rigors.

'**PERITONISM**'.—Term applied to group of symptoms, abdominal pain, vomiting, and shock, common to sudden involvement of peritoneum from any cause, e.g., rupture of any viscus.

'**LATENT PERIOD**'.—For short period, following peritonism, initial symptoms may improve, and almost subside, before those of peritonitis develop.

PROGRESS.—

FACIAL ASPECT.—Important sign of the 'acute abdomen': anxious expression, pinched and pallid, eyes sunken. Develops into '*facies Hippocratica*': eyes sunken, nose sharp, temples and cheeks collapsed, face livid, drawn, and anxious.

ABDOMEN.—(1) Distended and tympanitic (from intestinal paralysis); may be fluid and sometimes gas. (2) Immobility, no respiratory movement. (3) Tenderness extreme. (4) Muscular rigidity ('board-like').

VOMITING.—Early symptom; small amounts; painful, but with little effort or retching. First, stomach contents; then bilious; finally thin, slightly faecal fluid.

CONSTIPATION.—May be motion at onset: but subsequently constipation is complete for both faeces and flatus. Diarrhoea occurs in puerperal and sometimes in pneumococcal forms.

PULSE.—Rapid (110 to 150), small volume, high tension or 'wiry'; later, as the heart fails, becomes low tension or 'thready'.

TEMPERATURE.—Usually rises, often to 104°. May fall with later progress.

TONGUE.—Early: moist fur. Later: dry and brown.

URINE.—Either frequency or retention.

BLOOD CHANGES.—Marked leucocytosis (20,000 per c.mm. and upwards), with relative increase of polynuclear neutrophils (75 to 90 per cent). (See also LEUCOCYTOSIS and LEUCOPENIA.)

NOTES ON SYMPTOMS.—

TEMPERATURE.—Subnormal on occurrence of perforation; then rises, but falls as symptoms progress; in severe cases often no rise. Hence unreliable sign.

TENDERNESS.—To light pressure. Area corresponds to peritoneum, and is usually absent on palpation in loin posteriorly.

ABDOMINAL SIGNS.—(1) *Liver dullness* often greatly diminished in mammary line, but always present in axilla. (2) *Fluid* generally present, but recognition is usually difficult; may be movable dullness in flanks. (3) *Gas* may escape from a viscus.

Rarely, abdomen flat and rigid throughout course.

ABDOMINAL AUSCULTATION.—Complete silence on listening for long periods.

Termination and Prognosis.—Death in two to seven days, except in pneumococcal peritonitis, in absence of operation. Pulse becomes feeble and irregular, skin and extremities cold, general lividity, and collapse.

PROGNOSIS.—In event of operation, depends mainly on (a) pulse, (b) facies.

BACTERIOLOGICAL TYPES.—*Streptococcus*: all fatal. *Pneumococcus*: diffuse type is serious, localized type has good prognosis. *Gonococcus*: mortality low. *B. coli*: mortality depends largely on early operation.

Diagnosis.—*Characteristic symptoms*: (1) Abdomen: pain, tenderness, distension, rigidity, and, later, effusion. (2) Vomiting and constipation. (3) Rapid pulse. (4) Facial aspect. (5) Shock and collapse. Leucocytosis high.

DIAGNOSIS FROM OTHER CONDITIONS.—

1. **INTESTINAL COLIC.**—Constipation, lead, etc. Also renal colic. Differ in: intermittent paroxysms, pain eased or not increased by pressure.
2. **ACUTE COLITIS.**—Differs in: diarrhoea, pain colicky.
3. **ACUTE INTESTINAL OBSTRUCTION.**—Early stages: abdomen not distended or rigid (with exceptions, e.g., volvulus): vomiting profuse and faecal: pain colicky. Later, peristalsis. See p. 474.
4. **INTERNAL HÆMORRHAGE.**—Especially with ruptured tubal pregnancy and enteric. Extreme pallor, and breathlessness.

Acute General Peritonitis—Diagnosis, *continued*.

Rarely :—

5. HYSTERICAL PERITONITIS.—Simulation may be close.
6. ACUTE HÆMORRHAGIC PANCREATITIS.—Distension in upper abdomen : collapse extreme. Vomiting copious.

Occasionally :—

7. ACUTE PNEUMONIA.—Note facies and pulse-respiration ratio. May be abdominal pain and vomiting.
8. TWISTED OVARIAN CYST.—Tumour present.
9. TORSION OF TESTIS.—One undescended.

DIAGNOSIS OF ORIGIN.—Previous illnesses may be guide. *In perforation of gastric and duodenal ulcer* : Generally previous dyspepsia. *Appendicitis* : Commonest cause with previous good health, especially in children. *Enteric fever* : Sudden pain and tenderness, rapid pulse, falling temperature.

Special Types.—

PNEUMOCOCCAL PERITONITIS.—Usually children, age 3 to 7 years : 4 girls to 1 boy. May occur at any age.

ETIOLOGY.—(1) Idiopathic : nearly all girls (theoretically via Fallopian tubes) ; (2) Secondary to pneumococcal infection elsewhere.

SYMPTOMS.—Onset usually sudden : rigor, abdominal pain, pyrexia, vomiting, diarrhoea : abdomen tender and rigid as acute peritonitis (note diarrhoea) : general appearance may suggest pneumonia, with rapid respiration, malar flush, and delirium.

PROGRESS.—

1. *Diffuse Type*.—Pneumococcal septicæmia : may be rapid death, but recoveries occur (milder cases may often be undiagnosed).
2. *Circumscribed Type*.—Symptoms abate and then return with formation of abscess : this may rupture (umbilicus not uncommon).

DIAGNOSIS.—Blood may agglutinate infecting type of pneumococcus (transient).

TREATMENT.—Medical (*see* PNEUMONIA) : operation for abscess only.

GONOCOCCAL PERITONITIS.—In females, usually by extension from gonorrhœal salpingitis. May be diffuse. Usually pelvic. Pain and rigidity of lower abdomen, with gonorrhœal discharge. In males, extremely rare.

TREATMENT.—Rest. Vaginal douches. Abdominal fomentations. Laparotomy if constitutional symptoms increasing.

PUERPERAL PERITONITIS.—Following parturition, commonly second to fifth day, especially primiparæ. Usually streptococci marked by septicæmic symptoms : offensive uterine discharge. Spreads through uterus or Fallopian tubes, pain commencing in lower abdomen : great distension. Fatal about sixth day.

LATENT TYPE.—In old persons, e.g., in Bright's disease : symptoms slight. In enteric fever : symptoms may be slight, from dull mentality : suggested by falling temperature and rising pulse.

Treatment.—

OPERATION.—Except in pneumococcal and gonococcal type. While diagnosis is doubtful, give no drugs or food : fomentation may ease pain (avoid turpentine, to save skin). Fluid as desired. *After diagnosis*, morphia permissible while awaiting operation : but never while in doubt.

II. INTRAPERITONEAL ABSCESS : SUBPHRENIC ABSCESS.

Principal types : (1) Appendix abscess ; (2) Pelvic abscess ; (3) Subphrenic abscess. Also closely similar : (4) Acute diverticulitis.

Suppuration may spread to, or arise in, various areas on the abdominal surface of the diaphragm, constituting the difficult group known as 'subphrenic abscess'.

SUBPHRENIC ABSCESS.

Anatomical Relations and Varieties of Abscess.—Peritoneal reflections on the superior and posterior hepatic surfaces divide this area into : (a) Right and left, by the falciform ligament ; (b) Anterior and posterior, by coronary and lateral ligaments. Spread of intraperitoneal suppuration is thus partially limited, giving rise to the following varieties of abscess :—

1. RIGHT ANTERIOR (INTRAPERITONEAL) POUCH.—

RELATIONS.—On left, falciform ligament. Above, diaphragm. Below, liver. Posteriorly, right lateral ligament. In front, adhesions between transverse colon, diaphragm, and lower edge of liver. In absence of adhesions, is continuous with right posterior pouch, round right edge of right lateral ligament.

ORIGIN OF ABSCESS.—Appendix. Perforation of duodenal and gastric ulcers. Rarely, liver abscess.

2. LEFT ANTERIOR (INTRAPERITONEAL) POUCH.—Also known as *perigastric* or *perisplenic* pouch.

RELATIONS.—To right, falciform ligament. To left, spleen. Below, liver and stomach. Above, diaphragm. Behind, left lateral ligament.

ORIGIN OF ABSCESS.—Perforation of gastric ulcer.

3. RIGHT POSTERIOR (INTRAPERITONEAL) POUCH.—Also known as *subhepatic* or *right kidney* pouch.

RELATIONS.—Complex. Below, right kidney and transverse colon. Extends upwards to right and left between liver and diaphragm, with the folds of the coronary ligament between.

ORIGIN OF ABSCESS.—Appendix. Occasionally stomach and duodenum.

4. LEFT POSTERIOR (INTRAPERITONEAL) POUCH.—Formed by *lesser sac* of peritoneum. Foramen of Winslow closed by adhesions.

ORIGIN OF ABSCESS.—Perforation of gastric ulcer.

5. EXTRAPERITONEAL.—On 'bare area' of liver.

ORIGIN OF ABSCESS.—Liver abscess, or ruptured hydatid cyst.

Subphrenic Abscess—Anatomical Relations and Varieties, *continued*.

MOST FREQUENT TYPES.—Right and left anterior. In perforation of peptic ulcer, its position right or left of falciform ligament influences the direction of spread.

Limitation to pouches described is not absolute, and two, or parts of two, may be involved.

Commonest Causes.—(1) Perforation of gastric or duodenal ulcer; (2) Appendicitis, before or after operation.

Symptoms.—

DUE TO PERFORATED ULCERS.—Initial symptoms of perforation. These subside as localization occurs. After about ten days, symptoms of suppuration develop: *pyrexia* (rarely exceeds 102°), wasting, rigors or chills, irregular constipation or diarrhoea, with some pain in upper abdomen and increased respiration.

ARISING FROM APPENDICITIS.—Onset often insidious, with gradual development of symptoms of suppuration.

Physical Signs.—Vary with: (1) Presence or absence of gas; in absence of gas, may simulate empyema. (2) Position of abscess.

GAS PRESENT.—(1) A small amount often escapes on perforation: appears as movable bubble (diameter about 1 inch) in anterior varieties: resonant area either in epigastrium or behind ribs, according to patient's position. This movable 'bubble of air' is of great diagnostic importance, but entails careful examination. (2) Large amounts may escape from viscus, or form subsequently (anaerobic bacteria); physical signs closely simulate pneumothorax: *pyopneumothorax subphrenicus*. *Very rare*.

GAS ABSENT.—

1. **RIGHT ANTERIOR POUCH.**—(i) *Abdominal signs*: Epigastrium rigid. Palpable mass from under costal margin, dull on percussion; being limited on left by falciform ligament, does not extend beyond mid-line; but outline to left curved from bulging of ligament. From presence of adhesions, dullness does not move on respiration, and does not extend downwards beyond normal hepatic limits. (ii) *Thoracic signs*: Diaphragm may be pushed up, with dullness and deficient breath-sounds at base of lung. Heart may be displaced up, but not laterally.
2. **LEFT ANTERIOR POUCH.**—Similar to above, but on left of falciform ligament.
3. **RIGHT POSTERIOR POUCH (subhepatic).**—Signs difficult. No swelling. Tenderness and rigidity in right loin. Dullness and deficiency of breath-sounds at right base; heart not displaced.
4. **LESSER SAC.**—Tumour, dull on percussion, presenting below or occasionally above stomach: often absent. (Pancreatic pseudocysts). Diagnosis mainly by symptoms.
5. **EXTRAPERITONEAL.**—Diaphragm displaced up, and liver down. Moves on respiration. Signs at right base.

Course.—

WITHOUT OPERATION.—(1) May perforate diaphragm: extra-peritoneal type sometimes into pleura: other forms progress more slowly, hence pleural adhesions form, and rupture occurs into lung, with severe cough and expectoration. Occasionally discharge into intestines. (2) Chronic sepsis, fatal. Mortality without operation, 75 per cent.

WITH OPERATION AND EFFICIENT DRAINAGE.—Mortality at least 30 per cent.

Diagnosis.—Important are:—

HISTORY.—Previous peptic ulcer and symptoms of perforation; appendicitis; abdominal operations. Interval after acute symptoms, few days to several weeks: *often ten to twenty days.*

SYMPTOMS OF SEPSIS.—Temperature rarely exceeds 102°.

PHYSICAL SIGNS.—Often both abdominal and thoracic (base of right lung from extension of inflammation through diaphragm). Note 'bubble of air'.

X RAYS.—Displacement of organs, and abnormal shadows.

NEEDLING.—In lower intercostal spaces over dullness: along vertebral border of scapula. Test for pus to depth of three inches. Needle must always be completely withdrawn before inserting in a different direction. Many punctures often necessary.

DIAGNOSIS FROM.—Principally:—

1. **EMPHYEMA.**—In absence of gas. Pleural effusions and changes in the lung may coexist with subphrenic abscess.

2. **TROPICAL ABSCESS OF LIVER.**

3. **PERINEPHRIC ABSCESS.**

Rarely:—

4. **PANCREATIC DISEASE.**—In lesser-sac abscess.

5. **PNEUMOTHORAX.**—With large amounts of gas (very rare).

Treatment.—*Operation.***PELVIC ABSCESS.**

Secondary to inflammation of Fallopian tubes, around uterus or appendix. Symptoms of sepsis, with tenderness of lower abdomen: on examination per rectum or per vaginam, tender swelling, often fluctuating.

DIVERTICULITIS.

(See p. 486.)

III. CHRONIC PERITONITIS.**Varieties.—**

1. **TUBERCULOUS PERITONITIS.**—See pp. 166, 171.

2. **CANCEROUS PERITONITIS.**—See p. 555.

Not further referred to in this section. In some instances resembles the conditions found in the types following.

3. **CHRONIC ADHESIVE PERITONITIS.**—*Extension of inflammation from underlying structures.*

Chronic Peritonitis—Varieties, continued.

- a. Local : Especially (i) Pelvic ; (ii) Liver and spleen ; (iii) Diverticulitis, pericolicitis, and intestinal adhesions ; (iv) Pylorus, gall-bladder, and stomach.
- b. Diffuse.

4. CHRONIC PROLIFERATIVE PERITONITIS.

- a. Local, e.g., sugar-ice liver (Zuckergussleber).
- b. Diffuse.
- c. Polyserositis, polyorrhomenitis, or Concato's disease.

General Etiology.—Types (3) and (4) form an extremely difficult group of cases, further complicated by multiplicity of names. *Spread of bacterial inflammation* is an undoubted factor in certain cases, e.g., pelvic peritonitis, diverticulitis. Pathological changes of similar type, but of varying extent, may also occur in perisplenitis, perihepatitis, etc., and in diffuse peritonitis. At the other extreme is polyserositis, inexplicable as spread of ordinary inflammation, but with pathological changes similar to those which occur locally, e.g., 'sugar-ice liver'. Further, changes originally local tend to spread gradually over peritoneum.

The problem is complicated by frequent impossibility of deciding in given case, e.g., a sigmoid tumour, (1) to which type it belongs, (2) whether it is tuberculous. All forms tend to spread from site of origin.

Pericolicitis, *pericolicitis sinistra*, *perisigmoiditis*, *hyperplastic pericolicitis*, are synonyms for various local types.

CHRONIC ADHESIVE PERITONITIS.

Causes.—Include : (1) Ulceration of gut, not necessarily perforating ; (2) Spread through lymphatics of inflamed organs, or through diaphragm in pleurisy ; (3) Irritation of foreign bodies.

Varieties.—

LOCAL TYPE.—Common forms : (1) Pelvic peritonitis ; (2) Around liver and spleen ; (3) Diverticulitis and pericolicitis ; (4) Around pylorus, gall-bladder, and stomach.

1. **PELVIC PERITONITIS.**—From inflammatory diseases of pelvic organs.

Chronic Hæmorrhagic Peritonitis.—Rare. Vascular new fibrous tissue present : hæmorrhages occur and organize : perhaps comparable to hæmorrhagic pachymeningitis. Usually localized to pelvic peritoneum.

2. **LIVER AND SPLEEN.**—Adhesions common, mainly to diaphragm : found at autopsy. No symptoms known.
3. **DIVERTICULITIS.**—See p. 486.
4. **PYLORUS, GALL-BLADDER, AND STOMACH.**—Extent variable. With gall-stones may be marked pyloric thickening and adhesions. Sometimes peptic ulcer present, not necessarily perforated ; or catarrh of stomach. *Adhesions round stomach* may cause dyspepsia and vague pains. Division

at operation not always curative, owing to recurrence. Adhesions to liver common.

ADHESIONS OF SMALL INTESTINES.—Usual site, lower ileum (Lane's ileal kink).

DIFFUSE TYPE.—Widespread adhesions may be present: apparently with origin similar to localized forms.

Note.—In the more chronic cases, differentiation of either local or diffuse forms from chronic proliferative, tuberculous, or carcinomatous peritonitis is often impossible. (See **CHRONIC PROLIFERATIVE PERITONITIS** for symptoms and signs.)

Jackson's Membrane.—A fine membrane surrounding the cæcum but of varying extent: usually almost transparent, but occasionally opaque. Congenital in origin, probably an extension of the omentum carried down in descent of the cæcum (Gray and Anderson).

CHRONIC PROLIFERATIVE PERITONITIS.

SYNONYMS.—Chronic indurative, hyperplastic, or adhesive peritonitis. For *generalized cases* affecting all serous membranes, mediastinum, etc.: Polyorrhomenitis, polyserositis, Concato's disease. For *local forms*: Proliferative perisplenitis or perihepatitis, sugar-ice liver, Zuckergussleber, etc., depending on organ affected. Among *intermediate forms*: Pick's disease (pericarditic pseudo-cirrhosis of the liver).

Polyorrhomenitis, polyserositis, or Concato's disease is a widespread affection of peritoneum, pleura, pericardium, and mediastinum. Symptoms and physical signs of chronic proliferative peritonitis, pericarditis, etc., are combined. In early stages, generally very obscure.

Pathogenesis.—In generalized *polyorrhomenitis*, causal factors unknown: usually young subjects. Theories are: (1) Idiopathic overgrowth of fibrous tissue. (2) Tuberculous: often suggested, but no proof and no typical changes present, histological or bacteriological. (3) Spread from a local origin: certainly, local proliferative forms essentially tend to spread; also after repeated tapping for ascites, proliferative peritonitis may occur round site of punctures. There are also various inconclusive theories of 'toxic' action, e.g., from interstitial nephritis, products of pyogenic organisms, lead (unsupported).

Of local forms, *perihepatitis* (sugar-ice liver) is most frequent; usually about middle-age, commonly (not always) associated with chronic alcoholism. Is often accompanied by varying grades of more diffuse peritonitis and interstitial nephritis.

Thus, alcohol is a certain factor in some cases, but insufficient to account for all; tuberculosis is unproved; and other factors are unknown.

A succession of able Guy's physicians, from Addison to Hale-White, have held that recurrent ascites in chronic alcoholism is always due to peritonitis, and that with ascites purely due to alcoholic cirrhotic liver, life is not prolonged sufficiently for recurrence. Also they hold that perihepatitis of 'sugar-ice' type, with absence of jaundice, is definitely associated with, and the sequel of, interstitial nephritis.

Chronic Proliferative Peritonitis, continued.

Morbid Anatomy.—Extent and distribution very variable. Of changes described below, almost every combination occurs of the local and general type.

PERITONEUM.—Greatly thickened from fibrous tissue, $\frac{1}{4}$ to $\frac{1}{2}$ inch; glistening white; distribution irregular: areas of cartilaginous hardness; much contracted. *Omentum*: rolled transversely across abdomen, from thickening and contraction, especially on left side. *Mesenteries shortened*: intestines drawn against spine, with lumen narrowed and length shortened. In absence of fluid, may form a palpable irregular mass. Occasionally *pigmented streaks and patches*. Non-tuberculous nodules.

ADHESIONS.—Variable, local or general. Of all degrees, but often slight. Kinking of intestines may result. May be areas with organs involved in dense adhesions, e.g., pylorus to liver, gall-bladder and pancreas, cæcum and appendix, sigmoid.

EFFUSION.—Variable, *from slight to enormous*. Depends only partly on amount of adhesions. Occasionally 'chylous'.

LOCAL CHANGES OVER ORGANS.—Liver, spleen, etc., may be merely adherent, e.g., to diaphragm, as part of general peritonitis. In other cases thickening is mainly confined to certain sites, but changes are similar in character to general type.

LIVER.—'Sugar-ice liver' (Zuckergussleber): *perihepatitis*. Organ contracted, but thick capsule may strip easily. Liver substance often remarkably normal: some fibrosis (possibly spread from covering, or due to pressure), but advanced cirrhosis rare. Gastrohepatic omentum and portal vein may be constricted (whence ascites). Usually spleen and to some degree general peritoneum affected: also *interstitial nephritis*. Symptoms: (a) Similar to ordinary 'alcoholic cirrhotic liver', if change local: only distinguishable at autopsy. (b) Part of diffuse type or polyorrhomenitis.

SPLEEN.—Perisplenitis. Similar 'iced' spleen occurs, but rare unless liver also affected.

PYLORUS, GALL-BLADDER, LIVER, STOMACH, AND PANCREAS.—Dense adhesions may involve these, especially pylorus ('perigastritis'). (See also CIRRHOSIS OF THE STOMACH, p. 422.)

CÆCUM AND APPENDIX.—May be indistinguishable from the 'tuberculous cæcal tumour' (see p. 171).

SIGMOID.—Resembles chronic fibrous diverticulitis.

Symptoms and Signs in Diffuse Type.—Obscure. Variable with: (1) Extent; (2) Site of lesions; (3) Relation of effusion and adhesions. Intervals of comparative freedom. The most constant are:—

ABDOMINAL PAIN.—Variable and intermittent. No case is entirely free.

GASTRO-INTESTINAL DISTURBANCE.—Troublesome constipation, occasionally diarrhoea and vomiting, due to stenosis, kinking, and adhesions. *Anorexia, flatulence, and dyspepsia* common.

WEAKNESS AND PROGRESSIVE WASTING.

Variable: Pyrexia and rapid pulse; dyspnoea and respiratory symptoms (depend on thoracic changes). Occasionally: (Edema or thrombosis of legs; difficulty in micturition. Jaundice rare.

ABDOMINAL SIGNS.—

INSPECTION.—*Irregular and variable distension* (fluid and meteorism). Skin dry. Veins distended.

PALPATION.—Increased and doughy resistance. Various masses and tumours.

PERCUSSION.—Fluid, which may be encysted and not movable. Irregular resonant areas.

Friction sound rare.

PERICARDIUM AND PLEURA.—May be similarly affected.

Adherent pericarditis and pleurisy.

PROGRESS.—Insidious advance. Duration, usually years.

Symptoms and Signs in Local Type.—Depend on site: resemble local chronic tumours from other causes.

Diagnosis.—By long observation only. From chronic peritonitis of tuberculosis, of extension of inflammation, and from carcinoma, often impossible even at operation.

Treatment.—Symptomatic. *Paracentesis* when indicated: often repeated on enormous number of occasions. For definitely localized intestinal tumours, excision or various short-circuiting operations for temporary relief. Progressive nature generally contra-indicates operation. The dense adhesions and thickened peritoneum render operation prolonged, difficult, and usually unsatisfactory.

IV. NEW GROWTHS IN THE PERITONEUM.

Varieties.—(1) Benign neoplasms: fibroma, lipoma, myoma, angioma; all very rare. (2) Primary malignant neoplasms (sarcoma). (3) Secondary malignant neoplasms (carcinoma). (4) Cysts. Also: tuberculosis.

PRIMARY MALIGNANT NEOPLASMS.

HISTOLOGY.—*Sarcoma.* Growths formerly considered 'carcinoma', now interpreted as endothelioma or mixed carcinomatous sarcoma.

SARCOMATOSIS OF PERITONEUM: DISSEMINATED MILIARY NODULES.—Very rare. The retroperitoneal glands may enlarge, but viscera escape.

Very rarely: sarcoma in omentum and mesentery.

RETROPERITONEAL SARCOMA.—Not strictly a peritoneal neoplasm: origin from retroperitoneal connective tissue. At any age, especially under 5 years (next to tuberculosis, the commonest neoplasm of infancy). Immobile tumour extends forward near mid-abdomen, usually crossed by coil of gut; hence variations in resonance: hard, but pseudo-cysts common. No ascites. Constitutional symptoms of neoplasm. Local symptoms vary with size and extent.

New Growths in the Peritoneum, *continued*.

SECONDARY MALIGNANT NEOPLASMS.

HISTOLOGY.—Almost invariably *carcinoma*. (Peritoneum escapes in great proportion of abdominal neoplasms.)

PRIMARY GROWTH.—(1) In *ovaries*, most frequent; (2) *Pylorus*, stomach, intestine, gall-bladder. Very rarely breast, œsophagus.

SEX.—*Commoner in women*. After middle age.

VARIETIES.—

1. **DISSEMINATED MILIARY NODULES.**—Carcinomatosis of peritoneum. Size: from pin's head to pea. Often great effusion, masking physical signs. Peritoneum, in slow cases, may show changes described as proliferative peritonitis.

Characteristics in very chronic forms are: (i) Great thickening and contraction of the peritoneum; (ii) Rolled transverse omentum; (iii) Contracted mesentery and fixed intestines; (iv) Various adhesions and effusions.

2. **MASSSES OF GROWTH.**—Miliary nodules and changes as in previous type may also be present.

3. **COLLOID CANCER.**—Secondary to tumour in ovary or stomach. Sometimes possibly a primary growth (from Wolffian body). Attains enormous size. Masses palpable. No effusion.

EFFUSION.—Serous, hæmorrhagic, or 'chylous'. *Cytology*: endothelial cells; may be marked mitosis; diagnostic value doubtful.

DURATION.—Rarely exceeds six months from recognition.

DIAGNOSIS.—General characteristics: wasting, with recurrent ascites; after tapping, masses may be palpable. Diagnosis aided by: (1) Local primary tumours; (2) After middle age, large masses are usually cancer; (3) Inguinal glands or umbilical nodules. In hepatic cirrhosis, jaundice and enlarged veins are present, but diagnosis may be impossible, as also from tuberculosis and forms of chronic peritonitis.

CYSTS OF PERITONEUM.

Abdominal neoplasms frequently become cystic. Numerous other cysts occur: (1) Mesenteric cysts. (2) Dermoids and teratomata: mesenteric or retroperitoneal. (3) Urachal cysts. (4) Parasitic cysts: hydatids; very rarely cysticercus (no symptoms).

Mesenteric Cysts.—

ORIGIN.—Doubtful: possibly embryonic from remains of Wolffian body, or of intestinal epithelium.

MORBID ANATOMY.—In mesentery of small intestine: may be sessile and attached to intestine. Usually unilocular. Epithelium or fibrous-tissue lining. Contents: (1) *Serous*: contain albumin, cholesterin, and sometimes mucin. (2) *Chylous*: not uncommonly contain true chyle. (3) *Hæmorrhagic*: rare. Also (4) *Hydatid*, and (5) *Dermoid*.

PHYSICAL SIGNS.—(1) *In middle line*, near umbilicus. Usually more on right. (2) Round, definite outline, smooth and regular (except hydatid), tense: may fluctuate. (3) *Great mobility*, in

circular directions, but especially side-to-side. (4) *Dull, with resonant area in front*, from coil of intestine. Size, few inches upward. Large cysts often fixed by adhesions, and completely dull.

DURATION.—Many years.

SYMPTOMS.—Often slight. Pain and constipation from enlarging size; occasionally gastro-enteritis; rarely acute obstruction. *May suppurate.*

DIAGNOSIS.—Very difficult; especially from ovarian and from renal tumours. Large fixed cysts resemble pancreatic cysts, retroperitoneal cysts, and other fixed tumours.

Omental Cysts.—Very superficial and extremely mobile.

Retroperitoneal Cysts.—In retroperitoneal tissues. Position resembles mesenteric cysts, but fixed. No diagnosis possible from pancreatic cysts and fixed mesenteric cysts.

Urachal or Allantoic Cysts.—Rare. Origin from incomplete obliteration of urachus between bladder and umbilicus. In men resemble full bladder, but not removed by catheter. In women (rarer) resemble ovarian cyst. *Often become malignant.*

Treatment.—Removal if cyst lying free. If retroperitoneal pedicle, partial removal and drainage: total removal should never be attempted, owing to risk of uncontrollable hæmorrhage.

V. ASCITES.

(*Hydro-peritoneum.*)

The accumulation of *non-purulent* fluid in the peritoneal cavity.

Etiology.—Due to local obstruction of the portal system, or to certain general conditions affecting the circulation in which pleural and other effusions may occur.

LOCAL CAUSES.—

PORTAL OBSTRUCTION (Portal vein or main tributaries).—

(1) Terminal branches in liver: portal cirrhosis of liver; chronic passive congestion; syphilis. (2) Compression in the gastrohepatic omentum and hilus: enlarged glands (malignant, tuberculous, Hodgkin, etc.); neoplasms. Rare: perihepatitis and local chronic peritonitis; aneurysms.

CHRONIC PERITONITIS (*see p. 551*).—Tuberculosis, neoplasm, adhesive and proliferative forms. Hydatid cysts.

THROMBOSIS OF PORTAL VEIN.

BANTI'S DISEASE.—Probably from disease of veins of portal system.

TUMOURS.—Especially solid ovarian tumour.

GENERAL CAUSES.—

CARDIAC FAILURE.—Cardiac, pulmonary, or arteriosclerotic.

NEPHRITIS.—Especially chronic parenchymatous form.

Common causes: Portal cirrhosis of liver. Cardiac failure. *Not infrequent:* Chronic parenchymatous nephritis. Tuberculous peritonitis (especially in children). Carcinoma of liver.

Note.—Malignant disease of liver, pancreas, etc., often produces ascites by action of enlarged glands in hilus of liver. Syphilis

Ascites—Etiology, continued.

probably acts by presence of peritonitis. For the methods in which the various causes produce ascites, *see also* under the diseases separately.

Symptoms.—Progressive uniform abdominal enlargement. Various results of pressure on diaphragm and interference with thoracic and abdominal organs, depending on rapidity of formation rather than quantity. Fluid may be absorbed and return.

Physical Signs.—

INSPECTION.—Varying distension, commencing in flanks. When effusion large: skin tense; lineæ albicantes; navel prominent; superficial veins distended, flow from below up (extreme in portal thrombosis). Veins round navel distended; caput Medusæ, especially in hepatic cirrhosis.

PALPATION.—‘Fluid thrill’ transmitted through abdomen. A solid organ or tumour is palpated through a layer of fluid by ‘dipping’ with tips of fingers.

PERCUSSION.—(1) ‘Shifting dullness’. Percuss on back, and then on side. For small quantities, try knee-elbow position and percuss near navel (2) Flanks dull, centre resonant. In large effusions, general dullness.

Diagnosis.—(1) Shifting dullness (pathognomonic of effusion when obtained). (2) Fluid thrill. (3) Signs of portal-peripheral anastomoses (for routes, *see* CIRRHOSIS OF LIVER, p. 527). Diagnosis from:—

OVARIAN TUMOUR.—Dullness central, resonance lateral. Examination per vaginam may decide when doubtful.

LARGE HYDATID (‘hydatid thrill’); **PANCREATIC CYSTS.**—Diagnosis may be impossible.

Peritoneal Fluid in Ascites.—(*See also* PLEURAL FLUIDS, p. 596.)

SEROUS.—Clear light yellow; is usual type. Specific gravity: transudates, e.g., nephritis, under 1015; exudates (peritonitis) over 1015. (As regards diagnosis, the commonest specific gravity, unfortunately, appears to be 1015.) Albuminous. Occasionally clots spontaneously.

HÆMORRHAGIC.—In tuberculosis (commonest cause): cancer (highest relative percentage). Rare in cirrhosis. Also occurs in ruptured tubal pregnancy.

OPALESCENT.—

1. **TRUE CHYLOUS.**—Yellowish opacity due to fat, which forms layer on surface, cleared by ether. Rare. Occurs in affections of thoracic duct and lymphatics, also filariasis.
2. **PSEUDO-CHYLOUS.**—Opalescence due to lipid, soluble in alcohol, not in ether; small amount of true fat present; varies at different tapplings. Occurs in all forms, especially chronic parenchymatous nephritis. Prognosis bad.

CYTOLOGY.—Cells often difficult to distinguish, owing to degeneration.

1. **SMALL LYMPHOCYTES.**—In tuberculosis.

2. 'ENDOTHELIAL' CELLS.—Large cells with nucleoli. Predominant in passive and neoplastic effusions, but usually many present in all effusions.
3. CARCINOMA CELLS.—Extremely rare. Various nuclear changes, e.g., marked mitosis, are described, but rarely are reliable.

Treatment.—

MEDICAL.—Depends on cause. Aperients should be used only in moderation. Restriction of fluids, diuretics, salt-free diet, of little general value.

PARACENTESIS.—

INDICATIONS.—(1) Abdominal: great distension, pain, and alimentary disturbance. (2) Thoracic, from displacement of diaphragm: dyspnoea, collapse at bases, and cardiac disturbance.

TECHNIQUE.—(1) Empty bladder. (2) Choose site of puncture, mid-line above pubes (must be dull on percussion). (3) Inject 1 to 2 per cent novocain *ad lib.* (4) Sterilize skin with iodine. (5) Small incision through skin. (6) Trocar and cannula, medium size, plunged into peritoneum, trocar withdrawn, and fluid allowed to flow slowly; cannula strapped to skin with plaster. (7) Binder round abdomen, tightened at intervals. Fluid flows for several hours.

Alternative site (used after repeated punctures): Midway between the anterior superior spine and umbilicus; may perforate deep epigastric artery, causing serious hæmorrhage entailing ligature.

Section VI.—DISEASES OF THE RESPIRATORY SYSTEM.

CHAPTER LXXXVII.

DISEASES OF THE NOSE.

I. HAY FEVER.

An affection of the upper air-passages and conjunctiva, due to hypersensitiveness to proteins of pollen of certain plants.

Protein hypersensitiveness (allergy) is discussed under BRONCHIAL ASTHMA (p. 574), with which hay fever is closely allied and attacks often interchangeable. In Europe, hypersensitiveness in hay fever is solely due to pollen of grasses; in America, also, in fall, to pollen from ragweed: tested by conjunctival reactions to extracts of pollen.

AGE.—Commonest in young adults. Diminishes with age.

SEX.—More frequent in women.

Symptoms.—Attacks recur yearly in early summer.

PAROXYSMAL RHINORRHOEA.—

1. Sneezing fits.
2. Conjunctival irritation and lachrymation.
3. Nasal discharge, watery, copious, and continuous.
4. Headache and general depression.

Cough not uncommon.

GENERAL CONGESTION OF NASAL MUCOUS MEMBRANE present. Nasal discharge may be most prominent symptom (paroxysmal rhinorrhœa).

Duration.—Days to weeks. Depends on exposure to pollen.

Diagnosis.—Cutaneous reaction to pollen. Yearly recurrence.

Paroxysmal rhinorrhœa during other seasons usually due to allergy to other substances.

Treatment.—

1. **ACTIVE IMMUNIZATION.**—Increasing injections of extract of pollen. Extract of pollen of one grass protects against all: timothy grass (*Phleum pratense*) commonly used. Results very good. Immunize before attack commences.
2. **PASSIVE IMMUNIZATION.**—Dunbar's pollantin, specific anti-serum: locally applied to nose and conjunctiva before rising. Partially effective.

Sea voyage or prolonged absence from causal pollen may produce desensitization: tends to return.

NASAL TREATMENT.—Remove polypi and correct slight abnormalities, but extensive operations inadvisable. Cauterization of septum often of considerable effect.

II. EPISTAXIS.*(Bleeding from the Nose.)***Etiology.**—Causes are: (1) Local; (2) General.

1. **LOCAL CAUSES.**—Trauma; picking nose; insertion of foreign bodies; neoplasms, nasal, antral, etc.; polypus of septum. Rare: hereditary hæmorrhagic telangiectases.
2. **GENERAL CAUSES.**

AT PUBERTY.—Especially in delicate children.

ACUTE SPECIFIC FEVERS.—Onset of enteric, scarlet fever, etc. Also in *toxic* conditions.CONDITIONS WITH HIGH BLOOD-PRESSURE.—Arteriosclerosis, nephritis, hyperpiesis, cirrhotic liver. *Venous congestion*—e.g., mitral stenosis, whooping-cough, mediastinal neoplasms.

BLOOD DISEASES.—All severe anæmias and blood diseases.

ALTERATIONS OF ATMOSPHERIC PRESSURE.—E.g., occurs in mountaineering.

IN SUPPRESSION OF MENSES.—Rarely.

PROBABLE CAUSE ACCORDING TO AGE.—

CHILDHOOD.—Trauma, picking nose, foreign bodies, acute specific fevers.

PUBERTY.—Spontaneously.

MIDDLE AGE.—Blood diseases, neoplasms.

AFTER MIDDLE AGE.—High blood-pressure, neoplasms.

Diagnosis.—Occasional difficulty if blood be swallowed and vomited, or, rarely, coughed up.**Prognosis.**—Rarely serious: tends to clot. Death extremely rare.**Treatment, if necessary:—**

HÆMOSTATICS: Adrenalin (1-1000) applied to mucous membrane. Snake venom. Others useless.

COLD WATER or ICE to bridge of nose.

PLUG NARES, if serious. Hot-water bottles to feet: or legs to knees in hot water.

CAUTERIZE: If persistent from one site.

CHAPTER LXXXVIII.**DISEASES OF THE LARYNX.****I. ACUTE CATARRHAL LARYNGITIS.****Etiology.**—**EXCITING CAUSES:—**

1. COLD.—Coryza.

2. OVER-USE OF VOICE.

3. ACUTE SPECIFIC FEVERS.—Common in measles, influenza, small-pox.

4. LOCAL IRRITANTS.—Gases, hot liquids, foreign bodies.

Acute Catarrhal Laryngitis—Etiology, *continued*.

PREDISPOSING CAUSES.—Gout, alcohol and tobacco in excess, and possibly rheumatism. Overheated rooms.

AGE.—None immune, though cause varies. More serious in children owing to narrow glottis.

Morbid Anatomy.—Laryngoscope shows: mucous membrane of aryepiglottidean folds congested, cords red and swollen, mobility often impaired, some mucus.

Symptoms.—

ORDINARY ATTACK IN ADULTS.—(1) Tickling in larynx, irritated by cold air. (2) Voice husky. (3) Dry cough; slight sputum. (4) Constitutional symptoms mild.

SEVERE ATTACK.—Voice entirely lost; swallowing painful; pain over larynx. Dyspnoea rare.

IN CHILDREN.—More serious. Spasm and oedema may cause dyspnoea.

Diagnosis.—Rarely difficult. Nervous aphonia may be distinguished by laryngoscope.

Prognosis.—Never fatal. Prognosis for voice often important; may be permanently impaired. If not treated, chronic laryngitis may follow.

Treatment.—Rarely necessary except in children.

GENERAL.—

WARM, MOIST ROOM, with much **FRESH AIR**: temperature 60° to 65°.

DIET.—Light. Warm drinks. If dysphagia, *semi-solids* (custards, etc.), usually less painful than fluids. Sucking ice often eases.

ACETYSALICYLIC ACID gr. x, t.d.s., or diaphoretic mixture.

BOWELS OPENED FREELY: calomel gr. ij and salines.

TONIC during convalescence.

LOCAL.—

a. **EXTERNAL.**—Antiphlogistine, mustard leaf, cold compress or ice-bag (cold generally relieves best).

b. **INHALATION.**—Tinct. benzoini co. 3j in pint of water at 140° F.

c. **SPRAY.**—In oil atomizer, 5 per cent solution of menthol in paroline (Semon).

d. **LOZENGES.**—Troch. menth. c. krameria, or cocain. c. krameria.

II. CHRONIC LARYNGITIS.

Etiology.—Often chronic from onset; or follows repeated acute attacks. Over-use of voice is common factor. Alcohol and tobacco in excess often accessory.

Symptoms.—

1. **ALTERATION OF VOICE** and hoarseness: voice tires rapidly.

2. **TICKLING IN LARYNX**, with desire to cough.

Laryngoscope: Mucous membrane swollen; vocal cords thickened,

mucus on surface. Hyperæmia slight. May be weakness of adductor muscles.

Diagnosis.—Laryngoscopic examination in prolonged cases. Tuberculous, malignant, and syphilitic laryngitis may commence as chronic catarrh.

Prognosis for Voice.—Often permanently impaired. May be resistant to treatment.

Treatment.—Examine nostrils for obstruction. *Rest Voice.* Avoid hot rooms, loud speaking, alcohol, and tobacco. Same treatment as for acute attacks may be given. Local application to larynx, zinc chloride (gr. xx to ʒj), with laryngeal brush, alternate days for three weeks. Massage to larynx. At Mont Dore and La Bourboule, spa treatment is organized.

III. CEDEMATOUS LARYNGITIS.

(*Edema of the Glottis.*)

Very serious, owing to rapid asphyxiation and death. Never primary: secondary to local or general conditions.

Etiology.—Causes are:—

1. LOCAL.—

- a. TRAUMA.—Sharp foreign bodies, scalds, etc.
- b. SEQUEL TO ACUTE LARYNGITIS.
- c. SEQUEL TO CHRONIC LARYNGITIS.—Tubercle or syphilis.
- d. LOCAL INFLAMMATORY CONDITIONS (rarely).—Cellulitis of neck, erysipelas, diphtheria.

2. GENERAL.—

- a. NEPHRITIS, chronic or acute.
- b. ANGIONEUROTIC EDEMA.
- c. ACUTE INFECTIOUS FEVERS (rarely).

Symptoms.—

DYSPOŒA.—Sudden onset, rapidly increasing. May be inspiratory stridor. Voice disappears.

ON EXAMINATION.—Epiglottis greatly swollen, can be seen and felt; aryepiglottidean folds swollen and may meet. Edema may be subglottic. True vocal cords rarely affected.

Diagnosis.—By sudden dyspnoea and swollen epiglottis.

Treatment.—Ice to suck and to neck. Air moist. If severe, spray with cocaine 20 per cent, and scarify epiglottis. *Tracheotomy* without hesitation; in absence, mortality high.

IV. TUBERCULOUS LARYNGITIS.

Etiology.—Very rarely primary. Practically always secondary to pulmonary tuberculosis, though disease of larynx often advanced with but slight signs at apex.

Tuberculous Laryngitis, continued.

Morbid Anatomy.—Commences at posterior extremities of ary-epiglottidean folds, and on interarytenoid folds, and tends to spread forwards. On vocal cords, chiefly posterior half.

ON EXAMINATION.—

FIRST STAGE: Mucous membrane pale, thickened, and infiltrated.

SECOND STAGE: Tuberculous masses (rarely seen).

THIRD STAGE: Ulceration—broad, shallow, gray, covered with exudation. General appearance 'worm-eaten'.

DISEASE SPREADS: (1) Forwards to epiglottis, which may be destroyed; (2) By ulceration, causing perichondritis and necrosis of cartilages. Vocal cords thickened. Less often it spreads backwards to pharynx. Rarely, stenosis of larynx results.

Symptoms.—

ONSET.—Slight huskiness of voice and irritation. Later, hoarseness and aphonia.

COUGH.—As ulceration increases.

DYSPHAGIA.—Especially with ulceration of epiglottis or spread to pharynx. May be agonizing.

Diagnosis.—Based on: (1) Laryngoscope—pallor, infiltration, and ulceration; (2) Pulmonary tuberculosis; (3) Bacilli in sputum. Diagnosis from:—

1. **SYPHILITIC LARYNGITIS.**—Usually painless. Laryngoscope: more congestion, commences *at base of epiglottis*, ulceration deep. Scarring common.

Syphilis and tubercle may coexist.

2. **CARCINOMA.**—Papillary growth from vocal cords or ventricular bands; unilateral in early stage.

3. **LUPUS.**—Painless. Begins on epiglottis.

Treatment.—*Complete silence for many months.* Spray throat with menthol and olive oil, or 'spirone' (Churchill's inhalant—KI in acetone, glycerin, and water). Recovery in early stages.

If general condition good, ulcers should be cauterized or rarely, curetted. An ulcerated epiglottis may be removed (relieves dysphagia), but laryngeal condition may progress more rapidly afterwards.

PAIN.—Insufflation of orthoform, gr. v to x, half an hour before meals.

DYSPHAGIA.—Food semi-solid. Spray with cocaine, or orthoform insufflation, before food. Wolfenden position: head hangs over bed, and food is sucked through tube.

V. SYPHILITIC LARYNGITIS.

Of frequent occurrence.

Etiology.—

CONGENITAL SYPHILIS.—(1) In first six months or early years as catarrhal laryngitis; (2) At puberty as in tertiary syphilis.

SECONDARY SYPHILIS.—Resembles acute laryngitis, but very resistant. Occasionally ulcerates. Condylomata very rare.

TERTIARY SYPHILIS.—(1) True gumma; commences at base of epiglottis; results in (a) stenosis of larynx—may be extreme, (b) deep ulceration—less common. (2) Diffuse infiltration.

Symptoms.—Chronic laryngitis. Hoarseness. Cough rare. Almost invariably painless.

Treatment.—Antisymphilitic. Rapid relief with potassium iodide, though scarring may follow.

STENOSIS.—Dilatation by Schrötter's bougies may relieve, but recurrence usual. Tracheotomy may be necessary.

VI. CATARRHAL SPASM OF THE LARYNX.

(*Spasmodic Laryngitis. Spasmodic Croup.*)

Spasm of the larynx occurring with mild laryngitis. (Acute or catarrhal laryngitis applies to condition sufficient to cause obstruction in absence of muscular spasm.)

Etiology.—

AGE.—Two to four years. Rare under six months.

ADENOIDS and ENLARGED TONSILS.—May be present.

EXCITING CAUSE.—Chill. Indigestion.

Symptoms.—Previous slight cough. Dyspnoea and barking character of cough increase at night until child awakes with

ATTACK.—Respiration oppressed, crowing inspiration and croupy cough, husky voice, struggles for breath; signs of laryngeal obstruction, viz., recession of epigastrium and suprasternal fossa during inspiration; appears serious, child and parents terrified. Cessation rapid and child sleeps. Duration half to three hours. Attack recurs for two or three nights. Child fairly well during day. Never fatal.

Treatment.—

IMMEDIATE.—Emetic of pulv. ipecac, gr. x, every quarter-hour till vomiting. Steam kettle. Heat to larynx or hot bath. A little chloroform if necessary.

TO PREVENT RECURRENCE.—Vin. ipecac. ℥ij t.d.s. during day. Phenazone gr. ij at night. Avoid chills, but have fresh air in room.

LATER.—Treat adenoids if present.

VII. LARYNGISMUS STRIDULUS.

Laryngeal spasm, no inflammation present. Confined to children. Is a manifestation of tetany (q.v.). Rickets usually present. Adenoids rarely absent: need treatment.

Etiology.—

AGE.—About 18 months. Not under 6 months, rarely over 3 years.

EXCITING CAUSE.—Scolding, or any irritation.

Symptoms.—Onset at night or early morning. No cough or hoarseness present. Respiration ceases, period of apnoea: the child struggles for breath; becomes congested; seizure terminates

Laryngismus Stridulus—Symptoms, *continued*.

with crowing inspiration as spasm relaxes. Attacks at first occasional, may become very frequent. Chvostek's sign present. Carpopedal spasms not uncommon.

Prognosis.—Rarely, but occasionally, fatal.

Treatment.—

DURING SPASM.—Throw cold water on the face, or tickle fauces to relieve spasm; or hot sponge on larynx. Tongue pulled forward. Amyl nitrite, or, if necessary, a little chloroform. If recurrent, place in hot bath, and sponge head with cold water.

TREAT FOR CALCIUM DEFICIENCY.—In acute attack, intramuscular injection of calcium chloride, 1 gr. Subsequently as in **INFANTILE TETANY**.

Diagnosis in Conditions of Spasm or Obstruction of the Larynx.

Causing *croup*, crowing inspiration, in infants and children:—

1. **LARYNGISMUS STRIDULUS.**—Not under 6 months; no previous cough or hoarseness; onset sudden; definite period of cessation of respiration ('holding the breath'). Rarely fatal.
2. **CONGENITAL LARYNGEAL STRIDOR.**—Congenital; continuous; ceases after few months; no distress. Never fatal. Due to abnormality of larynx.
3. **CATARRHAL SPASM OF THE LARYNX.**—Previous slight cough or hoarseness; onset rapid but not sudden; no cessation of respiration; attacks intermittent. Never fatal.
4. **CATARRHAL LARYNGITIS (OR ACUTE LARYNGITIS).**—Previous cold, dyspnoea, and fever; dyspnoea progressively increases. Longer duration, no intermissions. Dangerous. May be simple or diphtheritic. (*See DIPHTHERIA*, p. 43.)
5. **WHOOPIING-COUGH.**—Previous cough. Paroxysm commences with short expirations before inspiration and whoop.
6. **IN PRESENCE OF ADENOIDS OR ENLARGED TONSILS,** cough may suggest inspiratory stridor and laryngeal obstruction.
7. **PAPILLOMA OF LARYNX.**—Diagnosis by laryngoscope only. Symptoms of chronic laryngitis.
8. **FOREIGN BODY.**

In adults:—

9. **IRRITATION OF RECURRENT LARYNGEAL NERVES.**—By mediastinal glands, tumour, or aneurysm (*see ANEURYSM OF THE THORACIC AORTA—PHYSICAL SIGNS*).
10. **CENTRAL NERVOUS LESIONS.**—*See DISEASES OF THE CRANIAL NERVES—VAGUS*.
11. **FUNCTIONAL.**—E.g., globus hystericus.

VIII. NEW GROWTHS OF THE LARYNX.

A. Innocent.—**PAPILLOMA, FIBROMA.**

'**SINGER'S NODULE**'.—Inflammatory thickening of epithelium due to faulty voice production. *Site*: Vocal cords, junction of anterior and middle third. *Symptoms*: Hoarseness or stridor. *Treatment*: Removal.

B. Malignant.—**VARIETIES.—**

1. **INTRINSIC.**—Within the cavity of the larynx. Metastases late. Epithelioma commonest.

2. **EXTRINSIC.**—Upper aperture, epiglottis, arytenoids, walls, commonest on epiglottis. Metastases early. Epithelioma; occasionally spheroidal-celled carcinoma; sarcoma rare.

SYMPTOMS.—*Hoarseness*: resists treatment. No pain at onset. Cough unusual. Later: pain, dysphagia, cachexia; septic pneumonia.

TREATMENT.—Surgical.

CHAPTER LXXXIX.**DISEASES OF THE TRACHEA.****I. TRACHEITIS.**

Acute Tracheitis.—Usually in association with catarrhal inflammation of upper air-passages.

CAUSES.—

1. Extension from coryza.

2. *Influenza*. Whooping-cough. Measles.

3. Inhalation of irritants: steam, poison gases; cold foggy weather.

SYMPTOMS.—Soreness behind sternum; often harsh, dry, painful cough. May be no bronchitis; voice may be normal.

TREATMENT.—If severe, as for acute bronchitis. Inhalations of tinct. benzoin. co.

Chronic Tracheitis.—

CAUSES.—(1) Sequel of acute tracheitis; (2) Chronic irritation, e.g., tobacco, inflammatory conditions of nose or larynx, tumours.

II. TRACHEAL OBSTRUCTION**Causes.—**

1. **IN LUMEN.**—Inhaled foreign body. Rarely remains; results may be: (1) rapid death; (2) foreign body is coughed out; (3) passes into bronchus.

2. **IN WALL.**—Fibrosis following inhalation of severe irritants. Cicatrization of wound or tracheotomy scar. Syphilis, tumours.

3. **OUTSIDE THE WALL.**—Pressure of thyroid ('scabbard trachea'), aneurysm, neoplasms of cervical glands, mediastinal tumours.

Symptoms.—

DYSPNOEA.—Inspiratory. May be sudden severer attacks.

TRACHEAL STRIDOR.—Inspiratory most marked. Audible earliest during sleep.

Accessory muscles of respiration contract forcibly. May be indrawing of lower ribs on inspiration.

Treatment.—Depends on cause.

CHAPTER XC.

DISEASES OF THE BRONCHI.

I. ACUTE BRONCHITIS.

Acute catarrhal inflammation of mucous membrane of trachea and bronchi, large and small. In smaller bronchi, constitutes capillary bronchitis (see BRONCHOPNEUMONIA, p. 66).

Etiology.—

AGE.—None immune. Frequent and serious in old people and children (dentition, rickets, and specific fevers).

SEASON.—Common at change of seasons. May recur yearly.

CHILL.—Often from downward spread of coryza (i.e., 'cold on the chest').

SOME PREDISPOSING FACTORS IN CASES OF 'CHILL'.—(1) Hereditary predisposition; some persons and families 'catch cold easily'. (2) Infectivity and epidemicity: occurs even apart from *B. influenza*. (3) Occupations: dust, hot atmospheres, sedentary occupations.

ONSET OF SPECIFIC FEVERS.—Constant in measles and whooping-cough. Rarely absent in enteric.

DEBILITATING CONDITIONS.—Nephritis, heart lesions, diabetes, gout, rickets, etc. Subacute attacks frequent.

IRRITANT GASES.—Chlorine, nitric acid fumes, etc.

Bacteriology.—Common: pneumococcus; also streptococcus, *M. catarrhalis*, *B. influenza*.

Morbid Anatomy.—Mucous membrane of trachea and bronchi red, congested, and covered with mucopus.

HISTOLOGY.—Proliferation and desquamation (catarrh) of epithelial cells and of ciliated epithelium. Mucous glands and mucoid cells active. Exudation on surface containing mucus, desquamated cells, and escaping leucocytes. Submucosa oedematous, leucocytic infiltration, vessels dilated, and glands active.

Symptoms.—

ONSET.—As in a 'cold'. General malaise. Heaviness in head. Gastric disturbance, and usually constipation. Hoarseness (from laryngitis) common. Pyrexia slight, rarely 101°–103°. Pulse full.

ONSET OF BRONCHIAL SYMPTOMS.—Cough. Tightness and oppression in chest. Dyspnoea on exertion only.

PROGRESS.—Three stages:—

FIRST STAGE.—Cough dry. Expectoration scanty and viscid.

SECOND STAGE.—Cough loose. Expectoration abundant and mucopurulent. Symptoms become easier.

THIRD STAGE.—Cough often paroxysmal. Expectoration purulent. Other symptoms passing away. In stage of convalescence, condition subsides, or may continue for long period. No hæmoptysis. Rarely streak of blood from pharynx.

Physical Signs.—

RESPIRATION.—Slightly increased.

ON PALPATION.—Bronchial fremitus.

ON AUSCULTATION.—Numerous râles and rhonchi, altering with coughing.

(Examine bases of lungs for bronchopneumonia.)

Course.—

IN HEALTHY ADULTS.—Reaches third stage in one week, and clears in two weeks.

IN CHILDREN.—Inflammation may extend to bronchioles, whence areas of collapse and bronchopneumonia (physical signs: patchy dullness and bronchial breathing).

IN OLD PEOPLE.—Mucus accumulates at base, with low pneumonia.

Diagnosis.—Rarely difficult.

IN PNEUMONIA.—Dullness and tubular breath-sounds.

IN BRONCHOPNEUMONIA.—Dyspnœa, high temperature; may be signs of consolidation.

Treatment (for adults).—

AT ONSET.—As for a 'cold': sufficient for mild cases. A warm bed and a hot drink, lemonade or whisky. A hot bath. A wrapper round neck and lin. camphoræ et ammon. to chest. Quinine (tinct. quin. ammon. $\mathfrak{z}\text{j}$ t.d.s.) occasionally effective. Avoid chills.

If condition is severe:—

GENERAL TREATMENT.—Bed. Room warm. Air moistened by steam kettle. Bowels open: calomel gr. ij–iv and morning saline. Much fluid. Hot drinks at night promote sleep and action of skin.

DRUGS.—Indications vary with stage:—

FIRST STAGE.—Cough dry and useless. Indication for:—

R	Tinct. Ipecac. ¹	|	Liq. Ammon. Acetatis ²	$\mathfrak{z}\text{j}$
	Spt. Ætheris Nitrosi ² aa $\mathfrak{M}\text{xx}$		Aq. Camphoræ	ad $\mathfrak{z}\text{ss}$

Every four hours.

¹ Expectorant and laxative; ^{2,3} Diaphoretics.

At night.—Hot drinks. Pulv. ipecac. co. gr. x to aid sleep.

Paraldehyde $\mathfrak{z}\text{ij}$ to $\mathfrak{z}\text{iiij}$ if necessary.

Inhalation.—Tinct. benzoin. co. $\mathfrak{z}\text{j}$ in pint of hot water.

SECOND STAGE.—Cough loose. Give stimulating expectorants:—

R	Tinct. Ipecac.	|	Tinct. Scillæ	$\mathfrak{M}\text{xv}$
	Ammon. Carb.		gr. iv | Infus. Senegæ	ad $\mathfrak{z}\text{ss}$

Every four hours.

Continue inhalations and applications. Avoid opium.

Severe paroxysms of cough: tinct. belladonnæ $\mathfrak{M}\text{x}$, replacing tinct. ipecac.

Acute Bronchitis—Treatment, *continued*.

THIRD STAGE:—Cough persistent. Expectoration free. Opium indicated as sedative :—

R	Tinct. Camph. Co.	℥xxx	Spt. Chloroform.	℥x
	Aceti Scillæ	℥xv	Infus. Cascarillæ	ad 3ss

Every six hours.

Heroin very valuable as linctus, e.g. :—

R	Terpin Hydrate	gr. j	Alcohol (90 per cent)	℥x
	Acetomorphine HCl	gr. ʒb	Glycerin	ad 3j
	Menthol	gr. ʒss		

Opium is contra-indicated if any cyanosis is present.

CONVALESCENCE.—Tonics.

II. CHRONIC BRONCHITIS.

Etiology.—(1) Onset insidious. May be excessive smoking, or infection in upper air passages. (2) Following acute bronchitis, repeated attacks. (3) With renal or cardiac affections.

AGE.—In later years.

SEASON AND CLIMATE.—'Winter cough'. Very frequent in Great Britain.

Morbid Anatomy.—Mucous membrane of bronchi atrophied and thin.

HISTOLOGY.—Little ciliated epithelium is present: layer of cuboidal cells remaining on basement membrane, or no cells left. A few leucocytes on surface. Fibrosis and some round cells in submucosa. Emphysema present.

Symptoms.—Recurrent winter attacks, or exacerbations. Patient may be free in summer.

1. **SHORTNESS OF BREATH**, marked on exertion.

2. **COUGH.**—Especially troublesome at night. Paroxysms may cause giddiness.

SPUTUM.—Usually abundant, mucopurulent, most in morning. Rarely none.

GENERAL HEALTH.—Often good. No fever. Subjects frequently become thin, but are often very stout persons, when cough is most trying.

EMPHYSEMA (rarely absent), and renal, cardiac, and other diseases present influence symptoms.

Physical Signs.—Mainly of emphysema: chest distended, expansion slight, prolonged expiration. Numerous râles and rhonchi.

Variations in Type.—

1. **DRY CATARRH** (Bronchitis sicca).—Not uncommon. Sputum scanty; severe and obstinate paroxysms of coughing.

2. **BRONCHORRHŒA.**—Sputum in large quantities (may be several pints daily). Usually purulent, in others watery (bronchorrhœa serosa). May persist for years, dilatation of tubes commonly occurring.

3. FŒTID BRONCHITIS.—Sputum fœtid; separates into two layers, upper fluid and frothy, and lower thick, containing Dittrich's plugs. Often temporary attacks.

Course.—Tends to be progressive. Asthma, bronchiectasis, cardiac dilatation may develop.

Diagnosis.—Exclude tuberculosis and bronchiectasis.

Treatment.—*Indications*: (1) General treatment important, especially to prevent recurrences; (2) Temporary measures to relieve symptoms; (3) Treat associated diseases—gout, heart, etc. Cardiac failure of special importance, owing to 'back-pressure' on lungs. Prophylactic vaccine treatment in early autumn.

GENERAL TREATMENT.—Mild climate in winter (South of England, Egypt, Florida, California). Special care during changes of temperature, climate, or residence. Good ventilation and warm fire. Diet rich in fats (cream or cod-liver oil). Breathe through nose, especially at night.

In exacerbations treat as for acute bronchitis.

TREATMENT OF SYMPTOMS.—Moderate cough and free expectoration good for patient. General treatment often relieves symptoms.

FOR MORNING COUGH, saline draught:—

R Sod. Bicarb.	gr. xv	|	Spt. Chloroform.	℥v
Sod. Chlor.	gr. v	|	Aq. Anisi	ad ʒj
In equal amount of warm water.				

IF COUGH DISTRESSING, some or all of the following:—

1. Lozenge (Troch. Glycyrrhizæ, *Brompton Hospital*):—

R Ext. Glycyrrhizæ	gr. iij	|	Troch. Acaciæ	gr. x
Ol. Anisi	℥ss	|		
Occasionally.				

2. Linctus:—

R Syr. Scillæ		|	Syr. Papaveris	
Syr. Limonis		|	Syr. Tolu	āā ℥xv
Occasionally.				

3. Mixture:—

R Tinct. Nuc. Vom.	℥v	|	Spt. Chloroform.	℥v
Ammon. Carb.	gr. iv	|	Infus. Senegæ	ad ʒss
Tinct. Scillæ	℥xv	|		
t.d.s.				

IF SPUTUM VISCID, give potassium iodide:—

R Pot. Iod.		|	Pot. Bicarb.	gr. xv
Ammon. Carb.	āā gr. ij	|	Aq. Camphoræ	ʒss

Inhalations useful: tinct. benzoin. co. ʒj to pint of very hot water.

IF COUGH VERY TROUBLESOME, give heroin or tinct. camph. co. (see ACUTE BRONCHITIS, p. 569).

FOR NIGHT COUGH.—Pil. ipecac. c. scilla (B.P., 1914) gr. iv at night; also heroin.

IF COUGH IS PAROXYSMAL, add tinct. belladonnæ ℥iij to pot. iodide mixture.

Chronic Bronchitis—Treatment, continued.

SLEEPLESSNESS.—With free expectoration, too long periods of sleep are inadvisable. Insomnia usually controlled by general measures. If necessary, alcohol or paraldehyde (3ij) at night. Morphia contra-indicated by severe emphysema or cyanosis: best as pulv. ipecac. co. gr. x at bedtime, or as heroin.

III. BRONCHIECTASIS.

(Dilatation of the Bronchi.)

Always secondary, except in rare congenital form.

Mode of Production.—Essential factor is *weakening of bronchial walls*. Of importance therefore are factors (1) tending to weaken walls directly, (2) leading to retention of secretion, either by pressure on bronchi or traction of contracting fibrous tissue, (3) causing infection of secretion. Such factors are: (a) Inhalation of foreign bodies, e.g., tooth, fragment of tonsil; (b) Fibrosis, resulting from pneumonia (as after measles and influenza), chronic pleurisy, pulmonary tuberculosis; (c) Pressure on bronchi by tumours.

CONGENITAL BRONCHIECTASIS.—Developmental defect of bronchial muscle.

Morbid Anatomy.—Lower lobe more affected than upper. Dilatations may be: (1) *Saccular*—rounded bulb-like dilatations, multiple, in radiographs like bunch of grapes; (2) *Cylindrical*—elongated with blunt ends like glove fingers, or fusiform with tapering ends. Walls of dilatations: smooth fibrous tissue; mucous membrane destroyed. Fibrosis extends into lung. Pleuritic adhesions common but not invariable. 'Lattice-lung': So called from radiographic appearance. Due to several bronchi opening into one epithelialized cavity; usually existing from childhood.

Symptoms.—Depend on degree of dilatation, and quantity and sepsis of secretion. In well-developed cases:—

1. **COUGH.**—In *paroxysms*. When secretion reaches sensitive mucous membrane. Especially in morning. Often one or two daily. Cough and expectoration follow change of posture.
2. **FÆTID SPUTUM.**—(a) Large quantities; (b) *Sweet, very offensive odour*. Separates into three layers: (i) Froth; (ii) Fluid; (iii) Heavy deposit, containing Dittrich's plugs, leucocytes, and crystals. Occasionally absent in early stages.

HÆMOPTYSIS.—Rarely large, but frequent in small amounts.

CLUBBING OF FINGERS.—Very common.

GENERAL CONDITION.—Pallor, some cyanosis, but generally health often fair. Breath offensive. Pyrexia slight or nil. Dyspnoea on exertion.

TOXIC FORMS.—Recurrent attacks of pyrexia, cough, and sputum. General condition deteriorates.

MILD GRADES.—Fætor may be absent. Periods of good health. Condition gradually advances.

Physical Signs.—Generally unilateral and at base. Chronic bronchitis and emphysema often present at unaffected areas. Heart may be enlarged.

INSPECTION.—May be signs due to fibrosis.

PERCUSSION.—Impaired, not absolute, dullness.

AUSCULTATION.—If dilatations empty, extreme amphoric breathing, râles, and rhonchi. If full, breath-sounds diminished, râles slight. In moderate grades, showers of râles at the base on inspiration.

RADIOGRAPHY.—With lipiodol. Diagnostic. See MORBID ANATOMY.

Dry Bronchiectasis.—May be no symptoms and unsuspected until hæmoptysis occurs. Radiograph diagnostic. Not uncommon.

Acute Bronchiolectasis.—Bronchioles dilated: lung has honey-comb appearance. Mainly young children after influenza.

Complications and Sequelæ.—

1. SEPSIS.—Especially abscess of brain. Septic bronchopneumonia, pleurisy, pericarditis, and gangrene of lung also occur: all fatal.
2. RECURRENT ATTACKS OF BRONCHITIS.
3. ARTHRITIS.
4. HYPERTROPHIC PULMONARY OSTEO-ARTHROPATHY.
—All stages, from clubbing of fingers—very frequent—to rare typical condition.

Diagnosis.—Usually simple by symptoms. Physical signs and radiographs confirmatory. Cavity at base with upper lobes clear suggests bronchiectasis. Diagnosis from:—

CHRONIC BRONCHITIS.

ABSCCESS OF LUNG.—Constitutional signs greater.

CONGENITAL CYSTIC LUNG.—Symptoms closely similar. Often of many years' duration without progress. Radiograph, with lipiodol, showing fluid level is diagnostic.

TUBERCULOSIS.—In bronchiectasis of upper lobe, tuberculosis is excluded by absence of tubercle bacilli.

Prognosis.—In fully developed disease, prognosis very bad, especially if bilateral. Occasionally fair health for years. Sepsis, cardiac failure, abscess of brain, gangrene of lung, and rarely hæmoptysis, cause termination.

Treatment.—Collapse operations indicated if unilateral, but not if bilateral. Foreign body, if present, must be removed.

- i. MEDICAL.—General health important.

Indications: (i) To promote emptying of cavities; (ii) To remove foetid nature of contents by antiseptics.

- i. To EMPTY CAVITIES.—'Postural coughing': head hangs over edge of bed, nearly to floor. Condition of heart may contra-indicate.

- ii. ANTISEPTICS.—

Creosote Chamber.—Crude creosote evaporated by lamp. Eyes covered by goggles strapped on. Ears and nose plugged. Duration 15 minutes, alternate days.

Bronchiectasis—Treatment—Antiseptics, *continued*.

Internal.—Creosote capsules, \mathfrak{Mij} t.d.s.

Inhalations.—For example: Creosote, spirit of chloroform, rectified spirit, equal parts; few drops on sponge of inhaler.

2. SURGICAL.—

- i. ARTIFICIAL PNEUMOTHORAX.—Good results in unilateral cases without pleural adhesions. Collapse for several years.
- ii. PHRENIC AVULSION (diaphragmatic paralysis).
- iii. THORACOPLASTY.—If previous measures fail.
- iv. LOBECTOMY (excision of area). Results now very good and mortality low.
- v. BRONCHOSCOPY AND ASPIRATION.—Good results by experienced operators.

IV. BRONCHIAL ASTHMA.

(*Spasmodic Asthma*.)

Attacks of paroxysmal dyspnoea, principally expiratory, due to spasm of bronchial muscles and oversecretion of mucus. Renal and cardiac asthma is not here referred to.

Etiology.—

ONSET.—May commence at any age; usually in childhood, uncommon after twenty-five years except with bronchitis.

SEX.—Somewhat commoner in males.

HEREDITY.—In high percentage: attacks usually commence at early age. Often in 'nervous' families, other members exhibiting epilepsy, migraine, neurosis, or urticaria, eczema, hay fever, etc.

CLIMATE AND ENVIRONMENT.—Subjects often very sensitive to these, but disease follows no rule.

Protein Hypersensitiveness and Exciting Causes.—Long recognized that attacks may be directly induced in certain subjects by emanations of animals and flowers or by ingestion of certain articles. Hypersensitiveness to a foreign protein is recognized as basal factor in asthma. A specific protein can occasionally be identified and by its removal from environment attacks can be prevented. This conclusion was based on: (1) Resemblance of asthmatic attacks to anaphylaxis experimentally produced in animals; (2) Liability of asthmatics to anaphylaxis after serum injections. Principal direct evidence adduced: (1) Skin reactions identifying a causal protein; (2) Effects of treatment. Earlier results suggested identification of a causal protein in 50 per cent of asthmatics, but, more recently, tests have proved far less successful. Note:—

a. Tests frequently negative to all obtainable proteins.

b. *Relation to Age*.—After middle age positive results very rare: rare in adult life. In children typical specialized reactions may be obtained.

c. Multiple Sensitiveness.—Positive reactions often obtained to more than one protein. Hence a positive reaction to a protein is not proof that it causes attacks.

CONCLUSION AS TO EMPLOYMENT OF TESTS.—Should be employed in children: occasionally a definite protein identifiable and attacks prevented. Useful results in adults practically negligible at present.

SKIN TESTS FOR PROTEIN HYPERSENSITIVENESS.—Extracts of many proteins are now procurable. An extract is placed on the skin, which is lightly scarified. If subject is hypersensitive to such protein, an urticarial wheal forms in about 20 minutes. Tests with many proteins usually necessary.

Causes.—

PROTEINS PRODUCING HYPERSENSITIVENESS.—Very numerous. Include:—

1. **INSPIRED.**—(a) Pollens of grasses, etc., viz., in hay fever. (b) Emanations of horses, birds (feathers), cats, etc.; scent of flowers.
2. **INGESTED.**—Commonest are: cereals, especially wheat; eggs; potato; milk; various fish and meat.

Doubtful.—Proteins produced or products split off during digestion; histamine, for example, produces anaphylactic phenomena. No evidence that hypersensitiveness is produced by proteins of bacteria.

REFLEXES AND ASSOCIATION WITH OTHER LESIONS.—

(1) Conditions of nasopharynx: polypi, deflections of septum, etc., often present, and treatment influences attacks. (2) Gastro-intestinal disturbances: heavy and late meals, flatulence, constipation. (3) Lungs: bronchitis may cause spasm in susceptible persons. (4) Pelvic disturbances in women. (5) Fatigue and emotion: psychical factor exhibited by an asthmatic knowingly sensitive to a rose developing an attack from an artificial rose.

Relations of Bronchial Asthma to other Affections.—Attacks may be associated with or interchangeable with hay fever, with some forms of urticaria and 'trophoneuroses', and with other conditions ascribed to hypersensitiveness ('allergy'). Also relations with various psychical disturbances.

Pathogenesis of an Attack of Asthma.—During attack, principal difficulty is expiration. Lungs assume position of forced inspiration, and little air passes in or out in spite of violent efforts.

Condition early recognized as involving: (1) Spasm of muscles of smaller bronchi. (2) Swelling of bronchial mucous membrane. These two factors cause obstruction of bronchioles: air cannot be expelled from alveoli, but is drawn in by more powerful inspiratory muscles until lungs are fully distended. A third factor is (3) Excessive secretion of bronchial mucus. This mucus, being retained, is coagulated by ferment, mucinase, in bronchial mucous membrane: on conclusion of attack is forced along spiral bronchioles and expelled as Curschmann's spirals (Hurst).

Bronchial Asthma, continued.

Morbid Anatomy.—With recurrent attacks, *emphysema* develops. May be extreme in young persons without associated bronchitis. No other changes post mortem.

Symptoms.—Attacks frequently nocturnal, after a few hours' sleep. ONSET sudden, or with premonitory symptoms of oppression in chest, paroxysmal sneezing, flatulence, polyuria, nervous depression.

PAROXYSM.—Violent respiratory movements with all accessory muscles; short inspiration, long wheezy expiration; little air entry. Respirations slow. Patient pale or dusky; anxious; cold sweat. Small pulse. At height of distress, paroxysm diminishes. Is never fatal.

CONCLUSION.—Rapid. Great relief. But paroxysm may recur.

COUGH.—Slight until end of paroxysm. Then patient brings up *viscid sputum* (see below).

DURATION.—Few minutes to several hours.

Physical Signs in Paroxysm.

POSITION.—Patient bends forward, grips objects tightly to fix scapulæ. Head thrown back. Shoulders raised: *scaleni* and *sternomastoids* contracted to lift thorax.

INSPECTION.—Thorax fixed in complete inspiration. Diaphragm lowered.

PERCUSSION.—Hyper-resonance.

AUSCULTATION.—Numerous râles and noises. No intake of air.

Sputum.

CURSCHMANN'S SPIRALS.—Expectoration commences as paroxysm passes: at first viscid, then looser. Contains small gelatinous masses, being spirally twisted casts of small bronchi. Microscopically, when unravelled, these consist of a clear central thread with mucin fibrils twisted round; often numerous eosinophils are embedded. Spiral ascribed to rotary action of ciliated epithelium. Spirals almost diagnostic of true asthma, but absent in old cases with *emphysema*. Very rarely recorded in acute phthisis, but no eosinophils. May continue two or three days after paroxysm.

CHARCOT-LÉYDEN CRYSTALS.—Colourless octahedral crystals. In other conditions also. Of no known importance.

Blood.—Marked eosinophilia may be present, these cells forming 5 to 30 per cent, or more, of total leucocytes.

Prognosis.—In children, attacks may cease. In adults, usually progressive. With repeated paroxysms *emphysema* develops. Thorax becomes deformed with high square shoulders and kyphosis of dorsal spine. Prognosis depends on such changes and cardiac condition. Pulmonary tuberculosis may develop.

Treatment.

INVESTIGATE CAUSE.—Relation to any factor of climate, diet, etc. Cutaneous reactions.

BETWEEN PAROXYSMS.—

1. GENERAL TREATMENT.—General health important. Treat constipation, flatulence, etc. For night asthma: light evening meal, avoid fatigue late in day, sleep before dinner.

2. FOR PROTEIN HYPERSENSITIVENESS.—

a. *Inspiratory*.—For HAY FEVER, see p. 560. Horse, cat, etc.: avoid contact.

b. *Food Proteins*.—Avoidance is necessary: desensitization usually follows prolonged abstinence: attempted immunization by injections of causative protein or increasing amounts by mouth is ineffectual.

Non-specific Immunization by Peptone.—Aims at effecting desensitization to any protein by injections of peptone. Peptone by mouth (0.5 gm.), one hour before meals, also tried. Results unconvincing.

3. VACCINES.—With chronic bronchitis, especially older subjects, prepare vaccine from predominant organism in sputum.

4. DRUGS.—With chronic bronchitis, give iodide, e.g.:—

R Tinct. Lobeliæ		Spt. Ammon. Aromat. ℥xx
Æthereæ	℥xv	Aq. Camphoræ ad 3j
Potassii Iodidi	gr. v	
	t.d.s.	

5. NASAL TREATMENT.—Remove polypi and correct slight abnormalities, but extensive operations are inadvisable. Cauterization often efficacious temporarily.

6. SPAS.—Mont Dore, Ems, etc. Attacks often cease at over 4000 feet, but unsafe with emphysema.

TREATMENT OF PAROXYSMS.—(a) *Adrenalin* (1-1000 solution), hypodermic injection of ℥ij-v, immediately attack commences: usually effective. (b) *Ephedrine* gr. ½-2 orally: slower, but can be given overnight. Amyl nitrite ℥v occasionally effective. Also aspirin overnight (may be hypersensitive). Avoid morphia, heroin, cocaine.

INHALATION OF FUMES.—Often relieves partially, but may aggravate bronchitis:—

Pulv. Stramon. Fol.	} aa gr. xv.
Pulv. Belladon. Fol.	
Pulv. Hyoscyami Fol.	
Potassii Nitratiss	

To be burnt in a saucer.

V. FIBRINOUS BRONCHITIS.

(*Plastic Bronchitis*.)

Essential feature is expectoration of accurate casts of smaller bronchi and bronchioles. Very rare.

Pathogenesis.—Method of formation of casts unknown. Localization to areas of lung is remarkable. In chronic cases, post mortem, emphysema is constant and tuberculosis frequent; nothing characteristic. Asthma frequent.

Fibrinous Bronchitis, *continued*.

Varieties.—(1) Chronic; (2) Acute.

1. **CHRONIC IDIOPATHIC FIBRINOUS BRONCHITIS.**—
Recurrent attacks; similarity of casts shows repeated involvement of same area. Not fatal, except rarely by asphyxia. May be several attacks in 24 hours.
2. **ACUTE FORM.**—In fevers, typhoid, pneumonia, etc. Considerable mortality. Casts *in situ* at autopsy. Fibrinous casts are expectorated rarely in chronic heart disease and pulmonary tuberculosis. Also in diphtheria, and small casts in pneumonia.

Symptoms.—Paroxysms of coughing and dyspnoea, or as in asthma, concluded by expectoration of cast.

Physical Signs during Paroxysm.—Area involved indicated by diminished breath-sounds and râles. Flapping of cast said to be audible. Collapse of the lung may occur in affected area.

Character of Casts.—Rolled up when expectorated. On unraveling, perfect casts of bronchi. May be 6 in. long. Consist of mucin.

Treatment.—No treatment prevents recurrence. Acute attacks treated as bronchitis: inhalations of steam and emetics may aid expulsion of casts. No reaction to adrenalin.

VI. BRONCHIAL OBSTRUCTION.

Causes.—

1. **IN LUMEN.**—Inhalation of foreign body.
2. **IN WALL.**—Fibrosis following inhalation of severe irritants. Cicatrization due to syphilis, tuberculosis. Neoplasms.
3. **OUTSIDE WALL.**—Pressure of œsophageal, mediastinal, or pulmonary neoplasms. Aneurysms.

Sequelæ.—(1) Collapse of lungs—sudden or gradual; (2) Septic processes in lungs, bronchitis, bronchiectasis, abscess, etc.

Symptoms.—Sudden obstruction: pain and cough. Later, symptoms depending on lung condition.

Treatment.—Depends on cause and sequelæ.

CHAPTER XCI.

DISEASES OF THE LUNGS.

I. PASSIVE CONGESTION OF THE LUNGS.

Occurs in two forms: (1) Mechanical congestion (brown induration); (2) Hypostatic congestion or hypostatic pneumonia (splenization of lung).

1. Mechanical Passive Congestion.—

CAUSE.—Obstruction to return of blood to heart. Occurs especially in diseases of left heart.

MORBID ANATOMY.—Known as 'brown induration' (or 'heart lungs').

MACROSCOPIC.—Bulky, tough, and œdematous. On section: brown surface, turning red in air.

HISTOLOGY.—(a) Increase of fibrous tissue; (b) Capillaries distended; (c) Blood pigment in alveolar walls; (d) Alveoli contain epithelial cells and altered blood pigment.

SYMPTOMS.—When *heart compensation fails*: *dyspnoea, cough*, and expectoration from engorgement of lung. *Hæmoptysis* not uncommon. Breath-sounds impaired and râles at bases.

TREATMENT.—Directed to cause, as in cardiac failure. Bleeding (20 to 30 ounces) of great value.

2. Hypostatic Congestion or Hypostatic (Low) Pneumonia.—

OCCURRENCE.—In enfeebling conditions, especially in old age.

a. **FEVERS**, especially typhoid.

b. **DEBILITATING STATES**, especially of brain—e.g., cerebral apoplexy, coma.

c. **ABDOMINAL TUMOURS, ASCITES**, by direct pressure.

CONGESTION AND COLLAPSE OF BASES result partly from gravity, partly from weak action of respiratory muscles and heart.

MORBID ANATOMY.—When advanced, condition is known as 'splenization of lung'. Bases, especially posteriorly, dark red, solid, airless, engorged, and pit on pressure; may sink in water; cut surface often resembles spleen, drips blood and serum.

SYMPTOMS.—Indefinite. *Dyspnoea* and cyanosis usually slight at onset; may become marked.

PHYSICAL SIGNS.—Râles at bases. Also diminished breath-sounds, and, when advanced, feeble bronchial breathing and impaired resonance.

PROGNOSIS.—Serious. Often fatal termination of illness. In causal states examine bases daily

TREATMENT.—

PROPHYLAXIS important: in old persons, typhoid, etc., move patient at intervals of two hours from one position to another.

INDICATION is to support and stimulate the heart.

II. ŒDEMA OF THE LUNGS.

Serous transudation from capillaries into alveoli and alveolar wall occurs in two forms: (1) Acute; (2) Chronic.

1. ACUTE ŒDEMA OF THE LUNGS.

Probably not very rare. Occurs in many conditions:—

1. **CARDIAC, MYOCARDIAC, AND RENAL CONDITIONS.**—Especially with, but not confined to, high blood-pressure. These are the usual causes.

2. **TOXIC CONDITIONS.**—E.g., acute specific fevers; pregnancy; diabetes.

3. **PARACENTESIS OF THE PLEURA.**—'Albuminous expectoration' in rare cases follows withdrawal of pleural exudate.

Acute Œdema of the Lungs—Occurrence, *continued*.

Amount withdrawn probably excessive; collapsed lung expands rapidly; injured vessels dilate, become hyperæmic, and allow fluid to pass.

4. **ANGIONEURITIC ŒDEMA.**—Probably local manifestation.
5. **ETHER ANÆSTHESIA. POISON GASES.** Venesection unnecessary as heart is not failing.
6. **IDIOPATHIC.**—Possibly early pneumonia or influenza.

Morbid Anatomy.—Lungs pale, semi-solid, sodden, markedly pit on pressure, and on section exude much frothy fluid.

Pathogenesis.—Welch's theory: Relative failure of left ventricle, while right is still acting, and blood accumulates in lungs until transudation occurs. May account for cardiac and renal forms, but against this is rise of blood-pressure. Other types possibly have various causes, e.g., urticaria.

Symptoms.—*Abrupt onset*, with oppression in chest and distress in breathing. Usually when lying down.

1. **DYSPNŒA.**—Becoming extreme.
2. **COUGH.**—Short and frequent.
3. **EXPECTORATION.**—After varying interval. *Copious*: watery frothy fluid: may be sanious. Occasionally no expectoration; patient drowns rapidly.

Distress, cyanosis, pallor, cold sweat, feeble pulse, develop rapidly.

Physical Signs.—Small bubbling râles. Percussion note resonant, may become dull later. Blood-pressure rises, may precede œdema (Graham). Hæmoglobin rises.

Prognosis.—Serious. May be fatal in few hours and even minutes.

Duration.—When there is recovery, few hours.

Treatment.—

MORPHINE.—Inject gr. $\frac{1}{4}$, with atropine sulphate gr. $\frac{1}{100}$.

RAPID CARDIAC STIMULANTS.—E.g., strophanthin (gr. $\frac{1}{160}$ intravenously).

BLEEDING (10 to 20 ounces), to relieve left ventricle.

OXYGEN inhalation.

ADRENALIN, 1–1000, 1 c.c. subcutaneously: may be repeated.

2. CHRONIC ŒDEMA OF THE LUNGS.

Occurs with all conditions of passive congestion.

III. HÆMOPTYSIS.

(*Blood-spitting*.)

Blood from mouth, nose, and pharynx is not regarded as hæmoptysis.

Causes.—The following are the most important:—

FREQUENT CAUSES.—

1. **PULMONARY TUBERCULOSIS.**—(a) Early.—Slight; capillary oozing. (b) Late.—Copious; vessels eroded.
2. **MITRAL STENOSIS.**

OCCASIONAL CAUSES.—

3. CERTAIN LUNG DISEASES.—(a) Pneumonia. (b) Infarct (occurs with heart disease). (c) Neoplasm, bronchiectasis, gangrene, abscess.
4. ANEURYSM OF AORTA.—(a) Sac weeps through eroded bronchi. (b) From erosion of lung. (c) Rupture of sac—copious.
5. ULCERATION OF LARYNX OR TRACHEA.—Syphilis, neoplasm, tubercle.

UNUSUAL CAUSES.—

6. PURPURA AND BLOOD DISEASES.—Very rare.
7. MALIGNANT SPECIFIC FEVERS.
8. *Paragonimus (Distoma pulmonale) westermanii*: lung fluke. Endemic hæmoptysis of China and Japan.

DEMANDING SPECIAL ATTENTION.—

9. IN APPARENTLY HEALTHY PERSONS.—See p. 150.
10. INJURIES TO CHEST WALL.—See p. 150.
11. VICARIOUS HÆMORRHAGE.—In suppressed menstruation.

Notes on foregoing List.—

COPIOUS, RAPIDLY FATAL HÆMOPTYSIS is confined to:

- (1) Advanced pulmonary tuberculosis (low case-incidence); (2) Aneurysm of aorta; (3) In mitral stenosis it may be profuse, but rarely fatal, and usually beneficial.

PNEUMONIA.—Occasionally profuse at onset. Rusty sputum constant in early stage.

VICARIOUS HÆMORRHAGE.—Accepted since the days of Hippocrates; now accused of being due to tuberculosis.

HYSTERICAL DECEPTION AND PURE MALINGERING.—Not uncommon.

Diagnosis of Hæmoptysis from Hæmatemesis.—

Hæmoptysis

1. Blood coughed up.
2. Blood frothy.
3. Reaction alkaline.
4. Sputum stained for several days.

Hæmatemesis

1. Blood vomited up.
2. Blood still, often dark.
3. Reaction usually acid (gastric juice); may be alkaline.
4. No staining of sputum.

* Patient's opinion usually reliable as to coughing or spitting.

Other points are: Previous history of cough or dyspepsia; tarry stools; tubercle bacilli in sputum; physical examination.

Treatment.—Noticeable are patient's mental excitement and often troublesome cough, which promotes further bleeding.

VARIETIES OF HÆMOPTYSIS.—Slighter forms—e.g., early tuberculosis—need no urgent treatment: importance is in diagnosis. Copious degree in mitral stenosis usually beneficial.

INDICATIONS.—(1) Calm patient; (2) Reduce heart-beats; (3) Prevent flooding of other bronchi.

CONTRA-INDICATED.—Alcohol and stimulants (fainting promotes clotting).

Hæmoptysis—Treatment, *continued*.

IMMEDIATE TREATMENT.—Reassure patient. Examination brief. Inject morphia gr. $\frac{1}{4}$ to $\frac{1}{2}$ (calms patient, eases cough, quiets heart). Posture: recumbent, shoulders raised, leaning on elbow on affected side, head hanging down; promotes expectoration and protects unaffected bronchi.

SUBSEQUENT TREATMENT.—Rest. Light diet. No alcohol. Open bowels with salines.

LOWERING OF PULMONARY BLOOD-PRESSURE.—Pulmonary circulation little understood, and attempts to influence it are best avoided. Ergot increases pressure, and is contra-indicated. Tinct. aconiti lowers pressure but weakens heart. Amyl nitrite excites heart. Ipecacuanha may cause vomiting.

DRUGS TO PROMOTE CLOTTING.—No evidence of any value. Congo red, intravenous injection of 10 c.c. of 1 per cent solution, has been recently tried.

IV. INFARCTION OF THE LUNG.

(*Pulmonary Embolism or Thrombosis. Pulmonary Apoplexy.*)

The clinical manifestations and pathological changes in lung tissue resulting from blockage of the pulmonary vessels by thrombosis or embolism.

Etiology.—Embolism may be caused by clot arising in:—

1. **SYSTEMIC VENOUS SYSTEM.**—Passes through right heart to pulmonary vessels. Some cases are due to primary *thrombosis* in the vessels and not to embolism. For causes, etc., see THROMBOSIS, EMBOLISM, etc.
2. **RIGHT SIDE OF HEART.**—(a) Clots form in auricular appendix in (i) cardiac failure, (ii) auricular fibrillation; (b) Vegetations (rare, usually infective).
3. **VARIOUS.**—Air emboli. Fat (after fractures).

Clot proceeds along artery until it occludes lumen. Although there is no essential difference, results are often referred to as: (a) Blockage of large vessels—*pulmonary embolism*; (b) Blockage of small vessels—*pulmonary infarction*—usual result when arising from the heart.

Symptoms.—All degrees of severity occur, depending on size of vessel involved: also on pre-existing disease, e.g., of heart.

SEVERE FORMS (large vessels—*pulmonary embolism*).—Onset *absolutely sudden*. Pain in chest. Dyspnoea extreme. Rapid distress and cyanosis. Unconsciousness may develop and death occur in a few minutes.

PHYSICAL SIGNS.—Usually those of cardiac failure only.

LESS SEVERE FORMS (smaller vessels—*infarct*).—Sudden pain in chest. Dyspnoea. In course of some hours or one to two days: cough. Blood-stained sputum. Pyrexia. Duration: a few days.

PHYSICAL SIGNS.—In early stages, indefinite; impaired movement and weakened breath-sounds. Later, pleurisy. Signs of consolidation develop of varying intensity: may be typically pneumonic.

Morbid Anatomy of Infarcts.—Mainly on periphery of lung; circular; dark, firm, raised above surface. Slight pleurisy. Wedge-shaped on section, greatest breadth on surface of lung. Size: walnut to orange or larger. Often multiple.

RECENT INFARCT.—Dark, solid, resembles blood-clot, alveoli distal to block being full of blood; pleurisy usual.

OLD INFARCT.—Organization, fibrosis, and contraction occur. If septic embolus (infective endocarditis), rarely may suppurate. **HISTOLOGY.**—Blood in air-spaces and walls, but tissue is not destroyed.

MODE OF FORMATION AND ORIGIN OF BLOOD.—*Uncertain.*

(a) Blood may be reflux from anastomosing bronchial arteries;

(b) Vessels may rupture behind block and fill alveoli, shape being due to distribution of alveoli.

Prognosis.—Usually complete recovery if patient survives initial few minutes.

Treatment.—Oxygen. Morphia. Venesection. Stimulants, if collapsed. Complete rest for many weeks. Operation: the clot has been removed from the base of the pulmonary artery.

V. COLLAPSE OF THE LUNGS.

The foetal lung may fail to expand after birth, constituting *congenital atelectasis*; lungs airless, pale, general resemblance to liver tissue. Of no clinical importance.

Collapse during life may occur in two forms: (1) Massive collapse—often known as 'lobar' collapse; (2) Passive collapse—may be lobar or lobular.

1. MASSIVE COLLAPSE.

Acute collapse of an entire or a large portion of a lung.

Occurrence.—

1. POST-OPERATIVE COLLAPSE.—Especially, but not confined to, abdominal operations near the diaphragm.
2. PARALYSIS OF MUSCLES OF RESPIRATION, e.g., diphtheritic.
3. INHIBITION OF MUSCLES OF RESPIRATION, e.g., pneumonia.
4. TRAUMA.—Usually, but not invariably, to the chest wall.
5. BLOCKAGE OF A LARGE BRONCHUS, i.e., by a foreign body.

Mechanism of Massive Collapse.—In civil practice principally studied in post-operative cases. During the war occurred frequently, instances falling into three groups: (1) *Penetrating wounds*, i.e., with hæmothorax: (a) Homolateral; (b) Contralateral of chest, viz., on opposite side to injury. (2) *Non-penetrating wounds*: (a) Homolateral; (b) Contralateral. (3) *Injuries elsewhere*, e.g., buttocks. Subjects were healthy men, without bronchitis, and injury in contralateral collapse was often noticeably trivial. There are two rival theories of the mechanism of collapse:—

Mechanism of Massive Collapse of the Lungs, *continued*.

1. **OCCCLUSION OF AIR-PASSAGES.**—When healthy lungs are removed from the body at autopsy, complete collapse does not occur: the collapse of the bronchioles rapidly occludes the lumen, and hence air in the alveoli cannot escape. But in life, such imprisoned air is absorbed by the blood, and hence complete collapse in the affected area follows occlusion of a bronchiole or bronchus. Collapse, lobular or lobar, hence results from any cause of such an occlusion. Is undoubtedly cause of massive collapse in blockage of a bronchus, and of extensive lobular collapse.
2. **INACTIVITY OF MUSCLES OF RESPIRATION.**—May result from: (a) Paralysis—e.g., diphtheritic, myasthenia gravis; (b) Inhibition, e.g., post-operative, trauma, pneumonia. The following points may be noted:—
 - i. Bronchitis of all types is extremely common, but massive collapse very rare. Hence another factor must be present.
 - ii. In many war and other cases there was no bronchitis or pulmonary condition which could block a bronchus.
 - iii. Chest wall is always immobile on affected side and diaphragm in position of full expiration.

CONCLUSION.—Either muscular inactivity or occlusion of bronchi may be primary factor.

Probable mode of action in muscular inactivity: Owing to chest wall being fixed in position of expiration, air entry is slight; air present in alveoli is then absorbed by the blood and not replaced; the lung consequently collapses, and hence the lumen of the bronchioles becomes occluded; thus collapse proceeds rapidly and massively.

Presence of bronchitis will aid such process. (Factors of intrathoracic pressure, elasticity of lung, etc., are very complex, and their influence in massive collapse has not been estimated.)

DISTRIBUTION OF INACTIVE MUSCLES.—Theories: (1) Lower intercostals and diaphragm. (2) Briscoe: excludes intercostals and argues mechanism of collapse as follows: Normally in supine position with quiet breathing, crural portion of diaphragm alone contracts (costal portion in abeyance); in debility, operation, toxæmia, etc., contraction of crural portion diminishes and deflation of lower lobe follows. Inflammation of pneumonia or pleurisy may start process and increase it.

Morbid Anatomy.—Affected lung bluish, firm, no crepitations, sinks in water.

Symptoms.—*Onset*: may be sudden with pain in chest. After injury, interval may be 1, 2, or even 6 days. Symptoms vary: patient may be extremely ill, but symptoms often slight at complete rest. Exertion, even moderate, produces marked dyspnoea, rapid respiration and pulse, and sometimes cyanosis and distress. Cough often slight: may be no sputum.

Physical Signs.—(1) Chest wall immobile: either smaller or larger than unaffected side. (2) *Heart and mediastrium displaced towards affected side.* (3) At affected base percussion note dull, air entry slight, breath-sounds definitely or distantly tubular or diminished, even entirely absent, adventitious sounds absent. May closely resemble and is often mistaken for pneumonia or pleural effusion (and often repeatedly tapped).

Fluid in the pleura necessarily alters these signs, but with collapse a heart in its *normal position* is consistent with a considerable amount of fluid.

RADIOGRAPHS.—Often diagnostic.

Progress.—Heart usually returns to normal site in about three weeks: often longer: occasionally in ten days. As lung expands, râles and sputum are common. Pneumonia, pleurisy, and effusions may develop.

Diagnosis.—From lobar pneumonia, pleural effusion, pneumothorax, pulmonary infarct.

Treatment of Extensive Collapse.—Varies with cause. General indications are to maintain strength with alcohol and stimulants, to provide oxygen for the tissues by oxygen inhalations or artificial respiration (in certain cases), and to promote respiration and expectoration.

2. PASSIVE COLLAPSE

Two varieties:—

1. Extensive Areas of Collapse.—

CAUSES.—

- Obstruction of a main bronchus, e.g., by increasing neoplasm.
- Mechanical cause, e.g., pleural effusion, pneumothorax, enlarged heart.
- Blockage of air-entry to smaller bronchi or bronchioles, e.g., bronchopneumonia, bronchitis, whooping-cough.
- Inhibition of muscles, e.g., bedridden subjects.

SYMPTOMS AND SIGNS.—Dominated by associated condition. Physical signs resemble massive collapse.

2. Small Scattered Areas of Lobular Collapse.—Common.

OCCURRENCE.—Definite pulmonary disease always present, e.g., bronchopneumonia and capillary bronchitis, especially in children; bronchiectasis; chronic bronchitis; oedema of bases, especially in old people, and in debility—e.g., enteric; occasionally in whooping-cough; rarely, fibrinous bronchitis.

MORBID ANATOMY.—Collapsed lobular areas are depressed below general surface, of purple tint, definite margin, and firm to pressure. On section: airless, fluid scanty, sinks in water. Especially in lower lobes and at margins. Areas may be extensive and lobar.

SYMPTOMS AND SIGNS.—Dominated by associated conditions. Increase of dyspnoea and cyanosis and rapid pulse occur. Physical signs usually indefinite: in children, inspiratory retraction of lower costal spaces and abdomen.

VI. FIBROSIS OF THE LUNG.

(Chronic Interstitial Pneumonia.)

Fibrosis of the lung occurs in various conditions, especially tuberculosis. In many forms pathology doubtful and exclusion of tuberculosis difficult, but undoubtedly it may occur as sequel of pneumonia, etc. (See also FIBROID PHTHISIS, p. 155.)

Fibrosis may be : (1) Local—portion of lung ; (2) Diffuse—involving one or both lungs.

1. LOCAL.—Occurs in :—

TUBERCULOSIS : a constant change.

NEOPLASMS, ANEURYSM compressing bronchi.

INFARCTS.

2. DIFFUSE.—Occurs in :—

CHRONIC TUBERCULOSIS.—Fibroid phthisis. Unilateral.

ACUTE PNEUMONIA.—Very rare sequel ; resolution fails, plugs organize, alveolar walls thicken (gray induration). Massive lobar type.

BRONCHOPNEUMONIA.—May occur in measles, whooping-cough, influenza, recurrent bronchopneumonia, and bronchitis. Fibrosis extends from bronchi. Bronchi dilated or bronchiectasis present. Insular type.

EXTENSION FROM PLEURA.—Pleura is thickened, and fibrotic process spreads into lung in strands. Deeper areas of lung unaffected.

PNEUMONOCOINOSIS (*see* p. 587).—From inhalation.

SYPHILIS (*see* p. 230).

Origin.—Fibrous process may commence in and spread from : (1) Peribronchial tissue, as in bronchopneumonic form ; (2) Alveolar wall, as in pneumonic form ; (3) Pleura and interlobular septa.

Morbid Anatomy.—Two main types : (1) Massive or lobar ; one or more lobes affected. (2) Insular or bronchopneumonic ; scattered areas.

1. MASSIVE TYPE.—Unilateral, usually lower lobe. Thorax and organs affected by contraction of lung.

LUNG.—Small, gray, airless, tough. *Pleuritic adhesions* constant. Bronchial dilatations not uncommon. If tuberculous : cavities at apex frequent, and other lung tuberculous. In pleurogenous form, pleura often half an inch thick. Unaffected lung emphysematous.

2. INSULAR OR BRONCHOPNEUMONIC TYPE.—Scattered pigmented fibroid areas ; especially lower lobe ; often central intervening tissue emphysematous. Pleura little affected. Bronchial dilatation and bronchiectasis very frequent. Most common type of non-tuberculous fibrosis.

'RETICULAR' FORM.—Intersecting fibrous strands. Very rare. Hypertrophy of the heart common.

Symptoms.—Condition chronic. Light work possible for many years. Symptoms of chronic bronchitis with exacerbations : (1) Chronic cough with expectoration ; (2) Shortness of breath, often only on

exertion. If bronchiectasis present, sputum foetid and other signs. *Pyrexia*: often absent, when chronic. *With cardiac failure*: usual symptoms, may be clubbing of fingers.

Physical Signs.—*Inspection* of main importance, results produced by contraction of fibrosed lung.

INSPECTION.—

1. Chest wall on affected side retracted and shrunken; shoulder drawn down; shoulder muscles wasted. Respiratory movement slight. Trachea may be displaced.

2. Heart displaced to affected side; may be entirely on right; if to left, large area of pulsation, and apex beat displaced upwards and outwards.

3. On measurement; affected smaller than unaffected side.

PALPATION.—Tactile fremitus *usually* diminished.

PERCUSSION.—Varies with dilatation of bronchi, bronchiectasis, and cavities. In general, resonance diminished.

AUSCULTATION.—Also varies as for percussion. In general, breath-sounds feeble at base, with bubbly râles; at apex, often amphoric quality.

UNAFFECTED SIDE.—Emphysematous: bulky and hyper-resonant.

All grades of above description occur.

Sputum.—Examine for tubercle bacilli; secondary infection common in all types.

Diagnosis.—*Inspection usually sufficient.*

DISTINCTION OF TUBERCULOUS FROM OTHER TYPES.—

(1) Tubercle bacilli in sputum (may be absent); (2) Opposite lung usually shows signs at apex. Often impossible to distinguish.

PRESENCE OF BRONCHIECTASIS.—Sputum foetid.

Prognosis.—Fair in absence of bronchiectasis and sepsis. Often 15 to 20 years. Death from failure of right heart; rarely hæmorrhage, amyloid disease, gangrene of lung.

Treatment.—Mild climate and general careful life. Treat as for chronic bronchitis and bronchiectasis, according to symptoms.

VII. PNEUMONOCOONIOSIS.

Definition.—Fibrosis of lung due to inhalation of dust in various occupations. The various forms include: (1) Anthracosis, coal miner's disease; (2) Silicosis, due to silica dust, as in gold-miner's phthisis on the Rand; (3) Siderosis, from metallic dust, e.g., tin, copper, lead, iron miners, and 'grinder's rot'; (4) Asbestosis; (5) Byssinosis, due to cotton dust.

Occurrence of Pneumoconiosis.—

METALLIFEROUS MINES.—In dry and dusty mines incidence very high. In dry rock-drilling, great mortality from microscopic silica dust. Tuberculosis and pneumonia frequent complications. Common in Cornish tin and South African gold mines.

STEEL-GRINDING.—'Grinder's rot' in Sheffield.

Pneumoconiosis—Occurrence, *continued*.

CHINA AND EARTHENWARE TRADES.—Special incidence among 'scourers' cleaning sand off porcelain after removal from kiln.
COTTON WORKERS.

In these and similar trades mortality now greatly reduced by working over gratings with down-draughts, by wet methods, by screens, by respirators, and by washing hands before eating. But, with silica, excessive wet increases incidence of tuberculosis.

Mode of Entry of Particles.—In some experiments, particles introduced into stomach have reached lung and produced pigmentation and fibrosis. Inhalation accepted as usual mode of entry.

Fate of Inspired Particles.—The air-passages can dispose of large amounts of dust, the nose and pharynx arresting some.

IN TRACHEA AND LARGE BRONCHI.—*Mucous corpuscles* ingest particles, cilia sweep them along, cough finally ejects them in sputum. With bronchitis, polynuclear neutrophils also present.

IN SMALL BRONCHI.—*Alveolar cells* desquamated from air-cells ingest particles.

ALVEOLI.—Little or no dust reaches these normally.

WHEN DUST IS EXCESSIVE, some particles penetrate bronchial mucosa, reach lymph spaces, and are ingested by phagocytic connective-tissue cells or special 'dust cells'.

Morbid Anatomy.—

1. **FIBROSIS OF LUNG.**—Characteristic change. Due to irritation of dust. Aggregations of 'dust cells' containing particles produce '*fibroid nodes*', especially marked in silicosis. Also diffuse fibrosis.

2. **TRACHEAL AND BRONCHIAL GLANDS.**—Particles become arrested and produce fibrosis. From periadenitis often adhere to pulmonary veins. Rarely, particles enter circulation by this route and reach liver and spleen.

In addition to *fibrosis*, other changes are:—

CHRONIC BRONCHITIS.—Constant, and cause of symptoms.

EMPHYSEMA, of unaffected portions.

BRONCHIECTASIS.

MACROSCOPIC APPEARANCE OF LUNGS depends on above changes, varying somewhat with cause, and with presence of tuberculosis.

IN ANTHRACOSIS.—Lungs black; pleural adhesions; pleura thickened, with extensions into lung; lung tissue hard and airless (crepitates in lesser grades); on pressure, cut surface exudes black fluid; areas of emphysema usual, mainly marginal. May be scattered, stony hard nodules (lung stones). *Bronchial glands* enlarged, black, and often adherent.

IN SIDEROSIS.—Lungs red and gritty.

IN SILICOSIS.—Fibroid nodes marked.

Asbestosis.—Diffuse fibrosis throughout lungs, and pleural adhesions. Lungs and sputum contain curious so-called '*asbestosis bodies*', irregular discoid golden-yellow structures containing iron. Onset of symptoms not until several years' exposure. Subsequently progressive.

Occurrence of Tuberculosis.—Pneumonoconiosis is non-tuberculous; it may remain so, and then is non-progressive when cause is removed (e.g., pure silicosis). Development of tuberculosis especially associated with dust of nature: (1) Particles very small (size of bacilli); (2) Relatively inert and insoluble. Such particles are ingested by cells, conglomerate, and form 'pseudo-tubercles' predisposing to tuberculosis.

ANTHRACOSIS.—Tuberculosis uncommon. Death-rate among coal-miners lower than general population.

SILICOSIS.—Main factor is microscopic particles of silica. Tuberculosis uncommon with silicates (clay), limestone, and slate quarries; common with quartzite and freestone.

Symptoms.—Several years elapse before onset of symptoms.

1. **COUGH.**—Usual initial symptom.
2. **DYSPPNEA.**—Marked, and out of proportion to physical signs; probably from emphysema.
3. **SPUTUM.**—Often characteristic—e.g., 'black spit' of coal-miners, and gritty in silicosis.

Physical Signs.—Very various, but not distinctive. Depend on chronic bronchitis, emphysema, fibrosis, and bronchiectasis.

PHTHISIS.—Presence mainly shown by constitutional disturbances and sputum. Physical signs indefinite.

Diagnosis.—By occupation and symptoms. Radiographs.

Treatment.—As for chronic bronchitis and emphysema.

PROPHYLAXIS in the mines and workshops is of great importance.

VIII. EMPHYSEMA.

Definition.—A disease of the lungs characterized pathologically by dilatation of the alveoli and atrophy of the alveolar walls.

Types of Emphysema.—(1) Hypertrophic; (2) Atrophic; (3) Compensatory; (4) Acute vesicular; and (5) Interstitial. Hypertrophic emphysema is of principal importance. The other types are briefly referred to at the end of the section.

1. HYPERTROPHIC EMPHYSEMA.

Also known as idiopathic or Jenner's large-lunged emphysema. Characterized by enlargement of the lungs, dyspnoea, and cyanosis.

Etiology.—

DILATATION OF ALVEOLI is the primary change. Theories of origin:—

1. **INSPIRATORY PRESSURE** (Lænnec).—Forcible inspiration distending the alveoli. Can explain compensatory emphysema and possibly type following asthma, but not accepted general cause.
2. **EXPIRATORY PRESSURE** (Jenner).—On forcible expiration, e.g., cough, glottis is closed and thorax compressed; over-distension of alveoli results, firstly at apex and anterior

Hypertrophic Emphysema—Etiology, *continued*.

margins of lungs, these being less protected. Theory supported by occurrence in players of wind instruments.

3. CONGENITAL WEAKNESS OF LUNG ELASTIC TISSUE.—Family tendency to emphysema recognizable.

4. FREUND'S THEORY.—Ascribes primary change to ossification of costal cartilages, emphysema being secondary. Not accepted.

Expiratory theory, possibly with some congenital weakness, is accepted as main cause.

INFLUENCE OF COUGH.—Emphysema almost constant with chronic bronchitis. May follow whooping-cough.

BRONCHIAL ASTHMA.—May produce in childhood pure emphysema without bronchitis.

AGE.—Common in middle and late life. No age exempt: occurs in children from asthma, whooping-cough, and recurrent bronchitis.

SEX.—Commoner in males.

MYOCARDITIS not uncommon concomitant.

Pathology.—The sequence of events is briefly as follows: The air cells distend from the over-pressure. This distension stretches alveolar walls and squeezes capillaries, and also possibly over-stretches elastic tissue. Malnutrition from lack of blood leads to atrophy of alveolar walls and finally to rupture, spaces resulting composed of several air-spaces. By coalescence of areas definite bullæ may form. Microscopic appearances correspond: large air-spaces lined with pavement epithelium, thin walls, little elastic tissue, and diminished capillaries. Emphysema is thus established in lungs, with diminution of alveoli and capillaries which perform aeration of blood, and of elastic tissue which contracts lung. Two sequels follow:—

1. Expiration becomes prolonged. The loss of elastic tissue diminishes power of contraction: increased duration is a partial compensation.

2. Inspiration becomes excessive—an attempt to compensate the deficient oxygenation of blood which results from fewer alveoli and capillaries.

With excessive inspiration and deficient elastic recoil and expiration, lung permanently assumes condition of full inspiration. Subsequently: (1) Chest wall becomes fixed in full inspiration, with ossification of costal cartilages; (2) Diaphragm is depressed. In this condition inspiration is effected by accessory muscles of respiration, scaleni and sternomastoids, which lift entire thorax. With reduced capillaries and deficient oxygenation, work of heart is increased; right heart hypertrophies and dilates; atheroma of pulmonary artery not uncommon. Finally cardiac failure occurs.

Morbid Anatomy.—

THORAX.—Barrel-shaped. Costal cartilages calcified.

ON REMOVING STERNUM.—Lungs do not collapse. Anterior margins occupy anterior mediastinum and cover heart.

LUNGS ON REMOVAL.—Do not collapse. Bulky, pale, and pit on pressure, and characterized by soft downy feel. Apex and anterior margins most affected; may be large bullæ. Changes bilateral. Bases often congested and œdematous.

BRONCHI.—In large tubes, chronic bronchitis. In smaller tubes, some dilatation, but bronchiectasis not common.

HEART.—Hypertrophy and dilatation of right ventricle. Often atheroma or dilatation of pulmonary artery.

OTHER ORGANS.—Effects of venous congestion.

Symptoms.—Result from deficient oxygenation of blood. *Chronic bronchitis* is invariably present, except in children with bronchial asthma.

1. **DYSPNŒA.**—Constant, especially on exertion. Paroxysmal attacks may occur.

2. **CYANOSIS.**—Extreme grade may occur with fair health.

3. **COUGH FROM CHRONIC BRONCHITIS.**—Rarely absent. Sputum usually scanty.

With age and recurrent bronchitis condition advances. Obesity not infrequent, but wasting in some cases. In children, dyspnœa on exertion may be sole symptom.

Physical Signs.—Bilateral.

INSPECTION.—Thorax 'barrel-shaped'; anterior-posterior diameter increased. Position of full inspiration: shoulders raised, clavicles prominent, intercostal spaces wide, sternal angle increased. Apex beat not visible. May be epigastric pulsation (right ventricle); also inspiratory retraction. Cervical veins prominent. Posteriorly: back rounded and scapulæ almost horizontal.

PALPATION.—Apex beat not palpable. Vocal fremitus normal or slightly diminished.

PERCUSSION.—Hyper-resonant. Cardiac dullness diminished, or rarely absent.

AUSCULTATION.—*Expiration prolonged*; inspiration short; no interval at end of inspiration. Râles and rhonchi. Breath-sounds diminished. Heart-sounds feeble but clear.

Course.—Progressive. Symptoms greatly depend on recurring bronchitis. Thus subject is often fit in summer and an invalid in winter. Care and good climate ward off many attacks, and duration may be 15 or 20 years. Finally cardiac failure, or occasionally pneumonia.

Prognosis.—Depends on degree of emphysema and bronchitis, and condition of heart and kidneys.

Treatment.—The process of emphysema is unaffected by any treatment. *Indications*: (1) Treat or prevent attacks of bronchitis or of asthma (*see* CHRONIC BRONCHITIS and ASTHMA); (2) Alleviate symptoms. In addition to treatment for bronchitis and asthma:—

OCCUPATION.—Alter if predisposing. Measures are frequently hindered by social position of patient.

Hypertrophic Emphysema—Treatment, continued.

CLIMATE.—Low altitudes (near sea level), warm, moist, free from dust and wind. High altitudes very unsuitable (rarefied air). Best localities are Assouan and South California; South Coast from Bournemouth to Penzance; Madeira; Algiers.

GASTRO-INTESTINAL MEASURES.—Flatulence aggravates dyspnœa.

EXTREME DYSPNŒA AND CYANOSIS AND CARDIAC FAILURE.—*Venesection* (20 to 30 ounces). Oxygen inhalations. Cardiac stimulants and treatment as in cardiac failure.

COMPRESSED-AIR CHAMBER.—Pressure of $1\frac{1}{2}$ to 2 atmospheres for 1 hour. Relief is transient; must be repeated frequently.

2. OTHER TYPES OF EMPHYSEMA.

Atrophic Emphysema.—Also known as senile atrophy of the lungs and Jenner's small-lunged emphysema. Is a primary atrophy occurring in old age together with general atrophy; found in old withered people. Condition contrasts with hypertrophic type. Thorax small; ribs oblique. On removal, lungs not bulky, collapse readily; on section, large vesicles recognizable.

Compensatory Emphysema.—Is secondary to pulmonary lesions. Over-expansion of lung tissue results as a necessary sequel from contraction or failure to expand of other portions. Occurs locally near patches of bronchopneumonia or tuberculous scars and cavities, or in fibroid phthisis in the entire unaffected lung. In early stages, alveolar walls stretched; later, atrophy and rupture occur, producing true emphysema.

Acute Vesicular Emphysema.—Rapid distension of the lungs may occur with strong inspiratory efforts. Has been found in deaths from asphyxia. Also may occur in bronchopneumonia, whooping-cough, and asthma, and may be produced by pressure on vagi. Lungs hyper-resonant, with râles and prolonged expiration. Return to normal during life has been observed.

Interstitial Emphysema.—Escape of air into subpleural and connective tissue of lungs. No connection with true emphysema. Results from wounds of lungs, rarely from rupture of air-vesicles during violent cough, and occasionally after tracheotomy, the air spreading down from wound. Spontaneous pneumothorax may thus arise in healthy persons.

IX. GANGRENE OF THE LUNG.

Etiology.—A rare condition. Results from putrefaction of necrotic areas. Method of production doubtful, but chief rôle assignable to anaerobic bacilli. May occur in variety of conditions:—

1. SEPTIC BRONCHOPNEUMONIA.—Origin:—

a. ASPIRATION PNEUMONIA.—In paralysis and diseases of larynx, wounds of neck, or in insane persons. Most frequent cause.

- b.* PERFORATION OF NEOPLASM OF ŒSOPHAGUS, ETC.; PRESSURE OF ANEURYSM OCCLUDING BRONCHUS; RUPTURE OF EMPYEMA, or of SUBPHRENIC OR HEPATIC ABSCESS; SUPPURATIVE OTITIS MEDIA.
- c.* CONTENTS OF BRONCHIECTATIC or very rarely of TUBERCULOUS CAVITIES.
2. BRONCHOPNEUMONIA, especially following measles. Rare.
 3. LOBAR PNEUMONIA.—Occasionally in diabetes or debility. A classical termination, but extremely rare.
 4. EMBOLISM OF PULMONARY ARTERY.—Usually septic. Rarely in enteric.
 5. INJURIES OF LUNG.—E.g., gunshot wounds. Very rare.
- PREDISPOSING CAUSES.—Diabetes, debility, and possibly alcoholism.

Morbid Anatomy.—Laennec described two types: (1) Diffuse, involving whole lung. Extremely rare. (2) Circumscribed. Line of demarcation surrounds gangrene; outside is area of congestion, and beyond this area of intense œdema. Gangrenous area at first greenish-brown, then softens, and cavity forms, ragged and offensive.

Symptoms.—Onset usually insidious. Prostration extreme. Fever variable, slight or hectic. Characteristic are: (1) Fœtor of breath; (2) Sputum, same odour. On standing, sputum forms three layers—viz., froth, greenish fluid, and greenish deposit, the latter containing elastic tissue, and often lung tissue, but no Dittrich's plugs. No characteristic physical signs. 'Latent' cases are discovered at autopsy, especially in diabetes: gangrenous area without opening into bronchus: no fœtor and no sputum.

Complications.—

1. PULMONARY.—(a) Bronchitis—invariable, except in latent form; (b) Hæmoptysis; (c) Pleurisy; (d) Pneumothorax—rupture into pleura.
2. ABSCESS OF BRAIN.—Frequent (cf. BRONCHIECTASIS, p. 573).

Prognosis.—Recovery rare.

Treatment.—Operative, if possible; collapse lung, or, if adhesions, drain freely. Otherwise, treat as BRONCHIECTASIS (see p. 573).

X. ABSCESS OF THE LUNGS.

Suppuration in the lung tissue. Often multiple. Always secondary.

Causes.—

1. ASPIRATION PNEUMONIA.—Paralysis and diseases of larynx, wounds of neck; insanity.
2. EXTENSION OF SUPPURATION FROM EXTERNAL SITES.—Rupture of empyema, subdiaphragmatic abscess, hydatid cysts; fractured ribs; rarely perforating wounds.
3. FOREIGN BODIES IN BRONCHI.—Inhalation pneumonia, e.g., fragment of tooth or tonsil after operation.

Abscess of the Lungs—Causes, continued.

4. **BRONCHIECTASIS, PERFORATION OF NEOPLASMS.**
5. **INFECTIVE EMBOLI.**—Multiple subpleural abscesses. Localizing symptoms rare.
6. **LOBAR PNEUMONIA.**—Rare termination, e.g., with diabetes.
7. **INFLUENZAL BRONCHOPNEUMONIA.**

Symptoms.—Constitutional symptoms marked, and phenomena of sepsis. May commence few days after removal of tonsils, etc.

PYREXIA, COUGH, DYSPNŒA, PAIN.

SPUTUM.—Only when communicating with bronchus. (1) Offensive, but not extreme sweet fœtor of gangrene and bronchiectasis; (2) Pus and elastic tissue present.

PHYSICAL SIGNS.—Small area of dullness; weak breath-sounds and râles.

LEUCOCYTOSIS.

RADIOGRAPHS.—Localized shadow. Cavity with fluid level, if connected with bronchus; lipiodol does not enter.

Complications.—*Pleurisy* (purulent) invariable if abscess reaches surface. Gangrene of lung, pericarditis, hæmoptysis, abscess of brain. When chronic, amyloid disease.

Diagnosis.—Difficult. Note elastic tissue in sputum. From: (1) Empyema; (2) Bronchiectasis; (3) Gangrene of lung.

Prognosis.—Grave. Following pneumonia, may recover; following aspiration pneumonia and foreign bodies, mortality very high.

Treatment.—Operative, including: bronchoscopy and aspiration; collapse of lung; removal of ribs and drainage (two-stage operation). Lobectomy may be possible.

XI. NEW GROWTHS IN THE LUNG.

Varieties.—

BENIGN TUMOURS.—Enchondroma, osteoma, etc. Extremely rare. Produce pressure symptoms.

MALIGNANT TUMOURS.—

PRIMARY.—Usually unilateral.

1. **Squamous Carcinoma.**—Forms hard white coarsely granular growth in lung root. *Microscopic*: Masses of flattened epithelial cells, may be cornifying. Origin from metaplastic bronchial epithelium. Metastases in local glands but not diffuse: hence lobectomy may be possible. Usually over 50 years of age.
2. **Columnar and Spheroidal-celled Carcinoma.**—Forms large soft pinkish masses with rapid dissemination and metastases. *Microscopic*: Columnar cells, but much variation in type, especially in metastases.
3. **Round-celled and 'Oat-celled' Carcinoma.**—Formerly described as 'lymphosarcoma' or 'sarcoma of mediastinum'. Large soft growth: rapid dissemination. *Microscopic*: Small round or oval ('oat') cells. About 40 years of age.

Intrathoracic tumours also include: carcinoma of œsophagus, lymphadenoma, sarcoma, leucosarcoma.

SECONDARY.—Not uncommon. Especially from: (1) Tumours of bone; (2) Chorion-epithelioma. Also from (3) Breast; (4) Alimentary canal; (5) Hypernephroma (invades renal vein); (6) Pancreas; (7) Suprarenal; (8) Thyroid. Also direct invasion from mediastinal and pleural growths.

HYDATID CYSTS.—Not infrequent site.

SYPHILIS.—Very rare.

Pathogenesis.—Neoplasms of lung have increased in frequency in recent years. Cause unknown. No evidence as to petrol fumes. No relation to gas poisoning in the War or to silicosis. Growth common in cobalt mines of Schneeberg but not other cobalt mines.

Etiology.—*Age*: Commonest about 50 years, but many younger. *Sex*: 4 males to 1 female.

Symptoms.—*Onset*: Indefinite. May be progressive dyspnoea or cough, or hæmoptysis and pyrexia. *Pain* not constant, but may be early and severe, from pressure on nerve-roots or pleurisy. Symptoms vary with site and extent of growth:—

1. **PULMONARY AND BRONCHIAL STRUCTURES.**—(1) Cough: rarely prominent. (2) Dyspnoea: becomes extreme with bronchial or tracheal pressure. (3) Hæmoptysis. (4) Sputum: 'prune-juice' expectoration, from mixture with blood: traditional, but rarely present.
2. **PLEURA.**—Recurrent pleural effusion suggests neoplasm. While fluid is often clear, yet neoplasm is frequent cause of persistent bloody effusion. May be pneumothorax.
3. **PRESSURE SYMPTOMS.**—Especially if mediastinal glands involved. (1) Unilateral œdema of thorax and head (may be extreme); (2) Dilated veins; (3) Pains in shoulder and arm; (4) Hoarseness (recurrent laryngeal); dysphagia; unequal pupils.

Progressive emaciation and anæmia. Pyrexia usually slight.

Symptoms as above may all be present.

Physical Signs.—If unilateral, side may be prominent. Signs vary with size of growth, pressure on bronchi and collapse of lung, presence of effusion, and excavation. With enlarged mediastinal glands, resembles mediastinal tumour. Supraclavicular glands may be palpable.

Radiographs.—May show: (1) Shadow of growth; (2) Pleural effusion (often obscures shadow); (3) Trachea displaced. *With lipiodol*, may show: bronchus blocked, shadow tapers ('rat-tail').

Diagnosis.—Usually difficult. Especially from: (1) Pleural effusion; (2) Phthisis; (3) Unresolved pneumonia; (4) Aneurysm; (5) Enlarged glands, Hodgkin's disease, etc.

New Growths in the Lung—Diagnosis, *continued*.

SPECIAL DIAGNOSIS.—

1. RADIOGRAPHY.
2. SPUTUM.—(a) 'Oat-cells' not uncommonly present; (b) Repeated absence of tubercle bacilli; (c) 'Prune-juice' expectoration.
3. BRONCHOSCOPY.
4. CHARACTER OF PLEURAL EFFUSION.—(a) Recurrent. (b) Sanious. (c) Cytology: absence of pus-cells, presence of endothelial cells (rarely small lymphocytes); presence of neoplastic cells is extremely rare.
5. PRESENCE OF PRIMARY TUMOUR.
6. SYMPTOMS.—(a) Progressive; (b) Wasting; (c) Fever absent or slight. May also be: (d) Pressure signs; (e) Supra-clavicular glands.
7. WASSERMANN REACTION.

Treatment.—Palliative. Disease always fatal. Paracentesis when fluid sufficient to produce symptoms. X-ray and radon applications disappointing.

CHAPTER XCII.

DISEASES OF THE PLEURA.

I. PLEURAL FLUIDS: THEIR EXAMINATION AND CAUSES.

Methods of Examination.—(1) Inspection; (2) Cytology; (3) Bacteriology. Also (4) Chemical.

1. INSPECTION.—May be: (a) Clear or turbid; (b) Purulent; (c) Hæmorrhagic; (d) Opalescent.

HÆMORRHAGIC EXUDATES (not hæmothorax).—Occur in: (1) Tuberculosis: rupture of newly formed vessels in the exudate. (2) Neoplasm of lung. Very rarely in chronic nephritis, cirrhosis of liver, severe fevers.

Any effusion, previously aspirated recently, may be hæmorrhagic from rupture of blood-vessels.

(Aspirating needle may cause bleeding into effusion.)

OPALESCENT EXUDATES (*Chylous Effusions*).—Most frequent in nephritis, rarely in neoplasms or after repeated aspirations: 'due mainly to a lipid soluble in alcohol but not ether, 'pseudo-chylous fluid'. True chylous fluid very rare: from lesion of thoracic duct or filaria.

PNEUMOCOCCAL FLUIDS.—Usually creamy pus with much fibrin.

FÆTID ODOUR.—Common when in communication with bronchus; also in bronchiectasis, gangrene of lung.

2. CYTOLOGY.—The cells present may be:—

a. SMALL LYMPHOCYTES.—In chronic inflammations; almost always tuberculous; fluid commonly sterile.

b. POLYNUCLEAR NEUTROPHILS.—In acute inflammations due to pyogenic organisms.

c. ENDOTHELIAL CELLS.—Principal cell in transudates: in effusions due to neoplasms, cardiac failure, nephritis, and non-inflammatory conditions. Fluid sterile.

Neoplasm may be suggested by numerous cells in mitosis.

d. NO CELLS PRESENT.—Not infrequent in transudates.

3. BACTERIOLOGY.—

a. IN PURULENT EXUDATIONS AND FLUIDS CONTAINING POLYNUCLEAR NEUTROPHILS.—Micro-organisms are:

(i) *Pneumococcus*: most commonly: prognosis good.

(ii) *Streptococcus pyogenes*: prognosis less favourable.

(iii) *Staphylococcus*: rare. Rarely: *B. influenzae*, *B. typhosus*, gonococcus, bacilli of colon group, e.g., *B. coli*, Friedländer's bacillus, *B. pyocyaneus*, etc.

b. IN FLUIDS WITH SMALL LYMPHOCYTES.—Tubercle bacilli practically never found. Nature confirmed by injections into animals, if necessary, and by cultures.

Principal Causes of Pleural Effusions.—

1. ACTIVE EFFUSIONS (EXUDATES).—

ACUTE INFLAMMATION.—(i) Lungs and pleura: e.g., pneumonia. (ii) Spread from extrathoracic infections: (a) Extension through diaphragm; (b) Septicæmia. (iii) Acute rheumatism (never purulent). Cells: Polynuclear neutrophils.

CHRONIC INFLAMMATION.—Tuberculosis. Cells: Small lymphocytes.

2. PASSIVE EFFUSIONS (TRANSUDATES).—Cells: Endothelial or none.

CARDIAC FAILURE.

ACUTE OR CHRONIC NEPHRITIS.

INTRATHORACIC NEOPLASMS.—(Rarely, small lymphocytes.)

Terminal in various debilitating conditions.

Occasionally with suppuration below the diaphragm.

3. HÆMORRHAGIC EFFUSION.—(See p. 596.)

4. OPALESCENT EFFUSIONS.—(See p. 596.)

II. ACUTE PLEURISY.

1. PLASTIC PLEURISY.

(Fibrinous or 'Dry' Pleurisy.)

Etiology.—

1. PRIMARY.—Follows cold or chill. May be several attacks. In healthy persons rare, without effusion. Most cases are probably tuberculous.

SYMPTOMS.—(a) Pain in side; (b) Cough; (c) Fever; (d) Friction sound—not always present, may be immobility

Plastic Pleurisy—Etiology, continued.

with slight signs of collapse only. No fluid present. Symptoms disappear in a few days.

2. **SECONDARY TO.**—(a) Lobar pneumonia. (b) Tuberculosis: common initial symptom. (c) Various pulmonary diseases when involving pleura; trauma, infarct, neoplasm, abscess, gangrene, etc.

Clinically, 'dry' pleurisy is frequently early stage of pleurisy with effusion, before occurrence of exudation.

2. PLEURISY WITH EFFUSION.

(*Sero-fibrinous Pleurisy*.)

Etiology.—

1. **TUBERCULOSIS.**—Onset may be:—

i. *After cold and exposure.* Frequent cause, pleurisy following directly. Most cases are tuberculous; this opinion is based on frequent occurrence of following evidence: (a) Tuberculous lesions often present, may be latent and previously unsuspected. Lesion sometimes found after aspiration of fluid. Tubercle bacilli in sputum in 15 per cent. (b) Tuberculous lesions found post mortem in accidental deaths. (c) Effusion cytologically resembles tuberculous fluid (small lymphocytes). (d) Effusion injected in large quantities causes tuberculosis in guinea-pigs. (e) Tuberculosis subsequently develops; including these with (a) accounts for 40 per cent of cases. Evidence is sufficient to prove that many cases are tuberculous; insufficient to show how many—owing to great variation amongst different authorities—or to prove completely that all are tuberculous. Occasionally pneumococci are found, and rarely streptococci, in cases not becoming purulent.

ii. *Idiopathic.* No cause discernible. Above arguments similarly apply.

2. **NEOPLASMS OF LUNG.**

3. **CHRONIC NEPHRITIS, and DEBILITATING CONDITIONS.**

4. **ACUTE RHEUMATISM.**—Rare. Usually with pericarditis, less often with endocarditis only. Pathology doubtful. May be 'dry' or with effusion.

5. **EXTENSION OF INFLAMMATION.**—With inflammation below diaphragm, e.g., subphrenic abscess, or in pericardium, serous effusions may occur.

6. **NON-PENETRATING INJURIES TO CHEST.**—Less common. Probably tuberculous.

7. **POLYSEROSITIS.**

AGE.—None exempt. Most common at 20 to 40 years.

SEX.—Twice as common in males (exposure to cold). For other types of pleural effusion, see pp. 596, 597.

Bacteriology.—Presence of organisms very rare in serous exudations, except in early stages of fluids subsequently becoming purulent.

Morbid Anatomy.—The changes are those common to inflammation of serous membranes. The fluid may be clear or turbid. *Hæmorrhagic exudate* suggests tubercle or neoplasm.

1. CHANGES IN THE PLEURA.—

MACROSCOPIC.—Early stage: loss of polish, surface injected. Then exudation of fluid or fibrin. Subsequently, fluid may be absorbed and adhesion of injured surfaces occur, or organization of fibrin result in irregular fibrous adhesions and sometimes 'loculated effusions'.

Adhesions vary from friable bands of lymph to strands of fibrous tissue or to universal adhesion of varying thickness. Adhesions most common near apex, on diaphragmatic surface, and over pericardium.

HISTOLOGY.—Endothelial cells proliferate and desquamate. Capillaries dilate. Leucocytes, escaping, infiltrate sub-endothelial tissue and reach surface of pleura. Exudation of fibrinous lymph containing endothelial cells and leucocytes.

a. In '*dry*' *pleurisy*, subsequently: Proliferation of connective-tissue cells; processes protruded into lymph, which is absorbed; new blood-vessels form; and fibrous-tissue union of the surfaces follows.

b. In *pleurisy with effusion*, subsequently: Fluid is absorbed through veins and lymphatics, and adhesions form as above by organization in the lymph and between injured surfaces.

2. **EFFECT OF EFFUSION ON THE LUNG.**—When effusion small, base and posterior border of lung are collapsed, blue, and airless, but contain blood and œdema. When effusion large, lung is compressed close to the spine, airless, gray, and bloodless ('carnified').

3. **DISPLACEMENT OF ORGAN.**—With large effusions the heart and mediastinum are displaced to opposite side, and diaphragm is depressed.

Symptoms.—

ONSET.—May be:—

1. **INSIDIOUS.**—Usual. Prodromal lassitude and dyspnoea: especially in children and old age.

2. **ABRUPT.**—In children there may be convulsions or vomiting.

CHARACTERISTIC SYMPTOMS.—(1) Pain in side; (2) Cough; (3) Some dyspnoea; (4) Fever.

1. **PAIN IN SIDE.**—Severe, described as 'stabbing'; aggravated by cough, deep inspiration, and sometimes by movement or pressure. Diminishes as effusion forms. *Site*: Usually lower axilla; may be reflected to abdomen, epigastrium, umbilicus, or iliac fossa, thus simulating appendicitis, more frequently in children.

2. **COUGH.**—Early symptom, occasionally absent; not so severe as pneumonia. Sputum scanty.

3. **DYSPNOEA.**—Slight, from fever and pain; later may be severe if rapid effusion compresses lung. With slow effusion, dyspnoea slight. Cyanosis not marked.

Pleurisy with Effusion—Symptoms, continued.

4. **FEVER.**—Rarely exceeds 102° to 103° ; rise less abrupt than pneumonia; duration about 7 to 10 days, usually.

POSTURE.—At onset patient lies on sound side to prevent pressure on inflamed pleura; after effusion, lies on affected side to allow expansion of healthy lung. Not constant.

PNEUMOCOCCAL PLEURISY.—Abrupt onset; temperature and crisis may closely resemble acute pneumonia.

Physical Signs of Pleural Effusion.—

CHARACTERISTICS OF EFFUSION.—(1) Absence of tactile fremitus; (2) Wooden dullness on percussion; (3) Breath-sounds diminished or absent; (4) Displacement of apex beat and organs. In early stage or 'dry' pleurisy: *friction rub* only.

INSPECTION.—*Displacement of apex beat. Immobility of side. Occasionally obliteration of intercostal spaces.*

PALPATION.—*Tactile vocal fremitus absent* or very slight (less definite in children). No oedema of wall. Liver and spleen may be depressed.

PERCUSSION.—Characteristic: *Absolute wooden dullness* felt by the finger. Dullness partly due to fluid and partly to compressed lung: earliest at base posteriorly. May reach clavicle, and include or extend beyond sternum. On right, merges indistinguishably into liver dullness. On left, Traube's semilunar area only obliterated by large effusions. Movable dullness is rare, and suggests pneumothorax. Other phenomena observed include:—

1. **ELLIS'S S-SHAPED LINE.**—In the erect posture, with medium effusions, the upper limit of dullness is not horizontal, but rises from spine to axilla, and then falls to sternum. Not marked in large effusions. Lying in bed, line slopes continuously from spine downwards. Is due to position of root of lung, and can be reproduced experimentally.

2. **GROCCO'S PARAVERTEBRAL TRIANGLE OF DULLNESS.**—Triangle of relative dullness along spine of opposite side to effusion, apex upwards, base $\frac{1}{2}$ to 3 inches. Very constant in thin people if fluid reaches 8th dorsal vertebra. Absent in pneumonia.

Theories of Causation: (1) Bulging of mediastinum; (2) Collapse of lung (persist for a time after paracentesis).

3. **SKODAIC RESONANCE.**—A tympanitic area often present above limit of dullness. Most marked under clavicle with fluid reaching the 4th rib. Ascribed to relaxation of lung above the fluid. Resembles tympanitic resonance, with slight impairment of percussion note.

AUSCULTATION.—

1. **EARLY STAGE.**—*Friction rub:* (a) Usually 'creaking' or 'leathery'; with inspiration and expiration; unaffected by cough; disappears with effusion. (b) Fine crepitations as in pneumonia—less common.

2. WITH EFFUSION.—

Breath-sounds.—(a) Over dull area: weak or absent; occasionally bronchial, especially in children. (b) Above dull area: harsh, loud, and often tubular; may be râles. *Vocal Resonance*.—Usually absent or diminished; rarely bronchophony.

Ægophony.—Nasal twang, common towards upper border of dullness; often at angle of scapula; attributed to thin layer of fluid.

Diminution of breath-sounds depends principally on compression of bronchi, and not on amount of effusion as such, fluid being a good conductor of sound.

EXAMINATION OF HEART.—Displaced away from effusion: area of cardiac dullness and audible sounds thus altered. Visible impulse is not necessarily true apex. Systolic murmur at base, when much displaced. In left effusions, pleuro-pericardial friction may occur.

MENSURATION.—With large effusions cross-section changes from elliptical to circular. Hence volume increases and size appears larger, with little change in measurement of periphery.

LITTEN'S SIGN.—Movement of the diaphragm. In thin normal persons, supine, with oblique light on the axilla, the 'shadow' of the diaphragm is seen moving with respiration; this is absent in pleural effusion, and often in other pulmonary diseases—e.g., pneumonia. In subphrenic abscess it may be abnormally high.

BLOOD COUNT.—No leucocytosis: count rarely exceeds 12,000 (except in the presence of associated conditions).

RADIOGRAPH.—Fluid gives shadow, often sufficient for diagnosis.

NATURE OF EFFUSION.—See p. 596.

In the interscapular region, over site of collapsed lung, tactile fremitus, tubular breathing, and bronchophony may be present even with considerable effusions.

For discussion of pleural effusion without displacement of organs, see **MASSIVE COLLAPSE OF THE LUNG**, p. 583.

Course.—Variable, depending on cause. Tendency is to be absorbed. Large effusions may compress vessels, causing delay. Aspiration now frequently employed. Immediate prognosis is good.

METHODS OF NATURAL TERMINATION:—

1. **ABSORPTION OF EFFUSION**.—Following 'chill' and in idiopathic forms, fever subsides by lysis, 7 to 10 days. In type of 'pneumococcal pleurisy', crisis may occur.
2. **LARGE EFFUSIONS ABOVE 4TH RIB**.—Absorption slow; often rapid after partial aspiration.
3. **EFFUSION PERSISTS UNCHANGED FOR MONTHS**.—Especially in tuberculosis.
4. **EFFUSION RECURS AFTER ASPIRATION**.—Suggests neoplasms. *Persistence and recurrence occur*: (a) If lung is permanently collapsed and inexpandible—e.g., after carnification; (b) With tight adhesions; (c) With persistent pleural irritation. *Collapsed lung* may persist: signs simulate fluid.

WITHOUT REMOVAL OF PUS.—Usually no tendency to absorption, and death by exhaustion or perforation.

a. **ANSORPTION.**—Small effusions. Pleura thickens and encloses inspissated pus. Very rare.

b. **EMPHYEMA NECESSITATIS.**—Rupture through chest wall: usually anteriorly in 6th space. Prognosis fair. Often chronic discharge.

c. **PERFORATION OF LUNG AND EVACUATION.**—Usually fatal choking. Pneumothorax may occur.

Perforations into pericardium, stomach, œsophagus, etc., are on record.

Prognosis.—Better in pneumococcal than in streptococcal infections.

Complications.—Rare, but commoner than in serous effusions.

Pericarditis, pneumothorax, abscess of lung, occasionally abscess of brain, bronchiectasis, gangrene of lung, nephritis.

Clinical Varieties.—

BILATERAL EMPYEMA.—Very rare.

'LOCULATED EMPYEMA'.—Pus may be enclosed by adhesions, between lobes ('interlobar empyema'), or on surface of diaphragm. Physical signs slight; paracentesis difficult.

'PULSATING EMPYEMA'.—Very rare. Effusion large, on left, usually pointing. Pulsation transmitted from heart, probably by pericardial adhesions.

PNEUMOCOCCAL AND STREPTOCOCCAL SEPTICÆMIA.—

Empyema often overlooked. Condition typhoidal.

TUBERCULOUS EMPYEMA.—See p. 156.

4. VARIOUS TYPES OF PLEURISY.

Diaphragmatic Pleurisy.—Inflammation of diaphragmatic pleura. Usually dry; purulent effusions very rare.

PAIN.—Over diaphragm and abdomen, or over shoulder.

PHYSICAL SIGNS.—Slight or absent, with marked pain and dyspnœa.

Loculated Pleurisy.—Effusion, usually purulent, separated into loculi by adhesions. Physical signs often doubtful. May be missed on puncture.

Hæmorrhage and Chylous Pleurisy.—See PLEURAL FLUIDS, p. 596.

Tuberculous Pleurisy.—See p. 171.

Epidemic Pleurisy. (*Epidemic Diaphragmatic Pleurodynia; Epidemic Myalgia; Bornholm Disease*).—Occurs as epidemics in institutions: occasionally sporadically. In summer or autumn. Cause unknown. Onset sudden, with some pyrexia: may be sore throat. Pain in lower thorax, back, and epigastrium. Tenderness marked. Muscles may be swollen. No cough. Headache. Malaise and constitutional symptoms vary: often slight. Pleural rub in some cases: usually loud. Leucocytosis. Progress: subsides in few days; tenderness persists for some period; relapses frequent. Effusion recorded, but doubtful. Prognosis good. No sequelæ.

DIAGNOSIS OF PLEURISY.

Dry Pleurisy.—*Friction rub* usually distinctive. Diagnosis from :
(1) Intercostal neuralgia and neuritis—no fever ; (2) Abdominal conditions ; (3) Herpes zoster, before eruption ; (4) Pott's disease ; (5) Periostitis of rib.

Pleurisy with Effusion.—

METHODS OF DIAGNOSIS.—(1) Symptoms ; (2) Signs ; (3) Exploratory puncture ; (4) Radiography. Questions are : (A) Is fluid present ? (B) What is its nature ?

A. PRESENCE OF FLUID. —

LARGE EFFUSIONS.—Diagnosis easy : (1) Immobility ; (2) Displacement of organs ; (3) Tactile fremitus absent ; (4) Wooden dullness ; (5) Breath-sounds usually absent. *Tactile fremitus* is most reliable of all physical signs.

MODERATE EFFUSIONS, without displacement. — Diagnosis from :—

a. *Pneumonia.*—In effusions : (1) Symptoms : not so abrupt ; no rusty sputum. (2) Signs : tactile fremitus absent, and wooden dullness present.

b. Old thickened pleura.

c. Neoplasm of lungs.

d. Massive pneumonia and collapse of lungs. Rare.

On Left Side.—From pericardial effusions : note are dullness, no displacement of heart, feeble heart sounds, marked dyspnoea. Difficulty increased by compression of lung.

On Right Side.—From subphrenic abscess.

B. NATURE OF FLUID.—(a) Signs of sepsis ; (b) Withdrawal and examination of fluid.

TREATMENT OF PLEURISY.

Dry Pleurisy.—*Indications* : (1) Relieve pain ; (2) Prevent extension.

Bed. Open bowels with calomel followed by saline purge.

To relieve pain : Apply leeches or strap side (extending over middle line back and front). Hot or cold applications. If severe, inject morphia.

Further treatment depends on cause and on occurrence of effusion.

Pleurisy with Serous Effusion.—(Confirmed by hypodermic needle.)

INDICATIONS FOR ASPIRATION AND AIR REPLACEMENT.—

1. Fluid increasing : especially when above 4th rib anteriorly.

2. Respiration or pulse affected.

3. Fluid not becoming absorbed (two to three weeks).

CONTRA-INDICATIONS TO ASPIRATION.—

1. Small effusions causing no embarrassment. Usually become absorbed.

2. *Tuberculous effusions.* Avoid aspiration if possible. If indications present, remove not more than 30 ounces, and replace with air. (Risk of generalizing tuberculosis.)

PARACENTESIS (ASPIRATION).—Inject novocain freely (2 per cent solution), commencing under skin and then inserting needle down to pleura. No general anæsthetic. Place patient's hand on opposite shoulder. Puncture in 8th space at angle of scapula, at upper border of rib. Small deep incision advisable. Withdraw the fluid slowly. Seal puncture with collodion. Strict asepsis. Gunewardene's syringe convenient.

SYMPTOMS DURING OR SUBSEQUENT TO ASPIRATION.—(1) Coughing: stop aspiration. (2) Faintness, from change of pressure and shifting of heart: give brandy. (3) Pneumo-thorax: rare. (4) Subcutaneous emphysema. Very rare: (5) Acute œdema of lungs and albuminous expectoration: fatal. (6) Sudden death: from syncope.

SUBSEQUENT TO ASPIRATION (NON-TUBERCULOUS).—

Encourage lung expansion by blow-bottles and deep-breathing exercises. Do not strap. Aspiration may be repeated.

AFTER-TREATMENT.—Examine for tuberculosis. Treat all cases with small lymphocytes in fluid as tuberculous. Prognosis fair with treatment.

Empyema.—

1. FROM PYOGENIC ORGANISMS.—

i. **CONTINUOUS ASPIRATION.**—Cannula inserted between ribs without resection. Continuous aspiration maintained by suction pump. Results very good.

ii. **RESECT RIB AND DRAIN FREELY.**—If amount large, aspirate some 48 hours previously. Drainage tube until *no* discharge. Breathing exercises to assist expansion of lung. Fresh air.

iii. **REPEATED ASPIRATION.**—Repeated aspiration very rarely curative. No objection to its trial with care in selected cases.

iv. **WITH CHRONIC DISCHARGE.**—Modified Estlander's operation, resection of ribs: allows chest wall to fall in. Results unsatisfactory. Wait at least one year before employing method. Sinus closes in time.

2. TUBERCULOUS EMPYEMA.—

ASPIRATE PUS. (Resection of rib is nearly always followed by secondary pyogenic infection and chronic suppuration.)

III. CHRONIC PLEURISY.

Chronic Pleurisy with Effusion.—Effusion may persist without becoming purulent.

Chronic Dry Pleurisy: Thickened Pleura.—Due to many causes (*see also* FIBROID LUNG).

i. **SEQUEL OF ORDINARY PLEURAL EFFUSIONS AND EMPYEMA.**—Pleuræ very thick. Flattening and lack of expansion at base; impairment of resonance and breath-sounds. Some dragging pain, or no symptoms.

2. **PRIMARY DRY PLEURISY.**—Commences with acute form, or insidiously. Symptoms slight. Adhesions commonly found post mortem. Litten's sign may be absent. Fibrous tissue, if thick, may invade lung (chronic cirrhosis of the lung).

Chronic Dry Pleurisy—Causes, *continued*.

3. POLYSEROSITIS: POLYORRHOMENITIS.—Very insidious. All serous membranes may be affected. (*See* p. 553.)
4. TUBERCULOSIS OF THE PLEURA.—Caseous masses in pleural membrane.

In chronic pleurisy of apex, there may be unilateral sweating of face and dilatation of pupil from involvement of first thoracic ganglion.

IV. HYDROTHORAX.

Non-inflammatory transudation into pleural cavity (*see* p. 597). Presence often suggested by dyspnoea. Physical signs as pleural effusion. In heart lesions is more frequent on right, possibly from pressure on azygos vein by dilated right auricle. Renal effusions are bilateral. Character of fluid: pale; specific gravity not above 1018; no fibrin; little albumin; cells endothelial or absent; sterile. Pleura smooth.

Treatment.—Aspiration: repeated if necessary.

V. PNEUMOTHORAX.

Hydropneumothorax: Pyopneumothorax.

Pneumothorax is air in the pleural cavity. Fluid is almost always present—i.e., hydropneumothorax, or, if purulent, pyopneumothorax. Owing to negative intrapleural pressure, when air enters, lung collapses, and mediastinum is displaced to opposite side.

Etiology.—Pulmonary tuberculosis accounts for at least 80 per cent in civil life. The causes of pneumothorax are:—

1. EXTERNAL ORIGIN.—

a. PERFORATING WOUNDS.

b. EXPLORING NEEDLE.—May prick lung; or diseased lung may rupture from rapid expansion after aspiration.

2. DISEASED LUNG RUPTURES INTO PLEURAL CAVITY.—

a. TUBERCULOSIS OF LUNG.—Commonest cause. Usually rupture of cavity or a caseous focus in acute phthisis. (In chronic forms adhesions and thickening usually protect.)

b. NEOPLASMS. Rarely EMPHYSEMA, ABSCESS, BRONCHIECTASIS.

3. PLEURAL CONTENTS RUPTURE INTO LUNG.—Empyema.

4. INFECTIONS OF PLEURA WITH ANAEROBIC GAS-FORMING BACILLI.—Very rare in civil life.

5. NEOPLASMS OF ALIMENTARY CANAL PERFORATING INTO PLEURA; ABSCESS OF LIVER PERFORATING LUNG AND PLEURA SIMULTANEOUSLY.—Very rare.

6. SPONTANEOUS PNEUMOTHORAX.—In healthy persons. Probably rupture of a single bleb.

Varieties.—Three forms of pneumothorax traditionally described:—

1. OPEN.—Perforation patent. Pressure is atmospheric.
2. CLOSED.—Perforation sealed.

3. **VALVULAR.**—Air enters during inspiration and cannot escape during expiration.

In last two forms intrapleural pressure may, and usually does, exceed the atmospheric, especially as fluid collects: hence displacement of organs is extreme.

Valvular form is most frequent.

(*Note.*—Pneumothorax due to gunshot wounds of the chest possesses certain special features, and is not considered in this section.)

Morbid Anatomy.—

Jet of air often under pressure if trocar inserted.

In thorax, a healthy lung is collapsed against spine: diseased lung often less. Usually serous fluid or pus present.

Opening often small: commonest in upper part of lower lobe or lower part of upper lobe.

Symptoms.—The onset may be:—

1. **SUDDEN.**—(a) Dyspnœa extreme; (b) Severe pain in side; (c) Symptoms of collapse, small rapid pulse.
2. **LATENT.**—Discovered accidentally; especially occurs when lungs diseased or tuberculous. Pleural adhesions prevent *mediastinal displacement*.

Physical Signs.—

INSPECTION.—

1. Immobility.
2. Marked enlargement.
3. Displacement of apex beat from affected side.

PALPATION.—Tactile fremitus absent.

PERCUSSION.—

1. Hyper-resonant or tympanitic note. Note varies with degree of intrapleural tension.
2. Cardiac dullness obliterated (if on left) or displaced from affected side. In right pneumothorax hepatic dullness displaced.
3. Shifting dullness at base if effusion present.

AUSCULTATION.—

1. Breath-sounds inaudible, or distant and amphoric.
2. Metallic quality to vocal resonance, râles (metallic tinkling), and cough. Typical in tuberculosis with solid lung and thickened pleura.
3. Coin sound (coin placed on chest and tapped by a second during auscultation at another point)—also known as bell or anvil sound or bruit d'airain. May be absent.
4. Hippocratic succussion: splash of fluid on shaking patient.*
Decisive of presence of air and fluid.

CHARACTERISTIC OF PNEUMOTHORAX.—Hyper-resonance with absent breath-sounds; also displacement of organs, metallic vocal resonance, coin sound, absence of fremitus, and immobility.

CHARACTERISTIC OF FLUID AND PNEUMOTHORAX.—Hippocratic succussion and shifting dullness.

* Beware of similar sound produced by a water-bed.

Pneumothorax, continued.

Diagnosis.—Usually easy. Radiographs generally decisive. Rarely difficulties from:—

1. **LARGE TUBERCULOUS CAVITIES.**—Especially in rare total excavation of one lung; but displacement of organs, shifting dullness, and Hippocratic succussion never present.
2. **PLEURAL EFFUSION.**
3. **GASEOUS SUBDIAPHRAGMATIC ABSCESS.**—Never extends to apex of lung. X-ray distinction.
4. **DIAPHRAGMATIC HERNIA.**

Prognosis.—Depends on cause:—

IN TUBERCULOSIS.—(1) In early rapid phthisis with rupture of soft caseation, death in a few minutes to a few weeks, from shock and strain to heart. (2) In older cases, accustomed to work with one lung, immediate prognosis less serious; may be chronic for years. (3) Occasionally followed by improvement. (*See also* ARTIFICIAL PNEUMOTHORAX, p. 161.)

SPONTANEOUS PNEUMOTHORAX.—Rapid recovery. No later ill effects. Subsequent tuberculosis rare. Occasionally air persists for years.

Treatment.—Conditions needing treatment are: (1) Acute onset; (2) High pressure of air; (3) Subsequent effusion.

1. **ACUTE ONSET, WITH SHOCK AND DYSPNŒA:**—
Inject morphia gr. $\frac{1}{4}$. Cardiac stimulants.

Give stimulants: ammonia and ether, brandy.

2. **HIGH PRESSURE OF AIR.**—Causes dyspnœa and cardiac distress.

Puncture with fine trocar if air under pressure (organs displaced). Often great relief. Subcutaneous emphysema avoided by pressure on puncture after withdrawal. Other dangers are negligible. Subsequent strapping may assist respiration.

3. **EFFUSION.**—Leave alone if no distress or signs of sepsis. In advanced pulmonary tuberculosis, aspirate for large or purulent effusion; avoid resection of rib unless signs of sepsis persist after aspiration. In other cases resect for purulent effusions.

VI. AFFECTIONS OF THE MEDIASTINUM.

1. NEW GROWTHS.

Varieties.—

1. **BENIGN.**—Very rare. *Note:* Retrosternal goitre; persistent thymus.
2. **MALIGNANT.**—Commoner in males. Distinction of primary and secondary often impossible.
PRIMARY.—Not very rare. (i) *Sarcoma* most common; lymphosarcoma and many other types. Origin from lymph nodes, thymus, and other structures. No special age incidence.

Many of these tumours are now regarded as carcinoma of the lung (*see* p. 594). (ii) *Carcinoma*: rare; in later decades.

SECONDARY.—By direct extension from lung, etc.

3. **HODGKIN'S DISEASE.**—May commence in mediastinal glands.

4. **DERMOID CYSTS, TERATOMA.**—Very rare.

Symptoms.—Result mainly from intrathoracic pressure; infiltration and metastases not very frequent. Origin of symptoms is discussed fully under **ANEURYSM OF THE THORACIC AORTA** (q.v.) Onset is usually insidious, with dyspnoea and cough resistant to treatment. Manifestations are due to pressure on and involvement of various structures:—

1. **TRACHEA, BRONCHI.**—Inspiratory stridor and dyspnoea. Cough may be 'brassy'. Bronchiectasis, collapse of lung. Displacement of trachea.
2. **LUNGS.**—Bronchitis, etc. Dyspnoea. Pleural effusion.
3. **VEINS.**—Dilated veins: oedema. Chest wall, face and neck.
4. **NERVES.**—(i) *Vagus*—paroxysmal cough; (ii) *Recurrent laryngeal*—hoarseness; (iii) *Sympathetic*—Horner's syndrome; (iv) *Intercostal nerves*—neuralgia. Rarely spinal cord.
5. **ESOPHAGUS.**—Dysphagia.
6. **ARTERIES.**—Hæmorrhage.

Physical Signs.—*Posture*: patient commonly sits up, with head thrown back. *Cyanosis*. Physical signs variable. *Cervical glands* may be enlarged. *Tumour* occasionally visible.

Course.—Rapid.

Site of Tumours.—

1. **ANTERIOR MEDIASTINUM.**—Origin from connective tissue or thymus. Special signs: sternum dull on percussion, pushed forward, oedema and pressure on veins common, cervical glands enlarged. Dyspnoea marked.
2. **MIDDLE AND POSTERIOR MEDIASTINUM.**—Less common. Origin from lymph glands. Symptoms in excess of signs: dyspnoea extreme, ringing cough, dysphagia.
3. **LUNG AND PLEURA.**—Rapid emaciation. Pressure signs slight. Effusion early. Cervical glands may be enlarged.

Diagnosis (*see* **ANEURYSM OF THE THORACIC AORTA**).—Often difficult. Wassermann reaction, radiographs, and aspiration assist. Also removal of an enlarged gland. Diagnosis from:—

1. **ANEURYSM.**—Similarity is due to pressure effects. Note:—
IN TUMOUR.—Cyanosis, pressure on veins, and pleural effusion more common.
IN ANEURYSM.—(1) Wassermann reaction always positive. (2) Diastolic shock and loud aortic second sound. (3) Expansile pulsation. (4) Tracheal tugging.
2. **LARGE PERICARDIAL EFFUSIONS.**—Shape of dullness and weak heart-sounds.
3. **PLEURAL EFFUSION.**—*See* p. 596.
4. **TUMOURS OF LUNG.**

Treatment.—Palliative. X rays and radon have little effect.

2. VARIOUS AFFECTIONS OF THE MEDIASTINUM.

Lymphadenitis.

CAUSES.—Inflammation of the glands in the mediastinum, especially tracheo-bronchial group at bifurcation, may be due to:—

1. TUBERCULOSIS.—Frequent. May spread from cervical glands or in children from Ghon's focus (*see* p. 164).

Temporarily:—

2. ACUTE FEBRILE CONDITIONS IN CHILDREN.

3. INFLAMMATORY CONDITIONS OF THE LUNGS.

SYMPTOMS.—Often absent or doubtful. Slight unilateral changes in physical signs, percussion, and auscultation. Suggested by spasmodic cough in children. Eustace Smith's '*venous hum*', audible at root of neck only when head thrown back: attributed to pressure of glands on large veins: value doubtful. *Radio-graphs*: Shadow at hilum (interpret with caution in adults).

Suppurative Lymphadenitis.

Abscess of tracheal or bronchial glands may occur: (1) In tuberculosis; (2) After simple adenitis. Occasionally they rupture in various directions. Tuberculous glands may inspissate.

Abscess of the Mediastinum.**VARIETIES AND CAUSES.—**

ACUTE.—(a) Trauma: perforation of œsophagus or trachea, abscess of lung, periostitis, septicæmia, bougies. (b) Acute fevers.

CHRONIC.—Tuberculous.

SYMPTOMS.—Pain behind sternum, with: (1) signs of sepsis; (2) mediastinal pressure (*see* TUMOURS).

PHYSICAL SIGNS.—Rarely definite. May be superficial œdema and dullness. Rarely a tumour at sternal notch. May rupture in any direction.

In chronic cases, inspissation commonly results.

Indurative Mediastino-Pericarditis.

A chronic fibrosis of the mediastinal tissues. May be tuberculous or no cause apparent. Rare. Onset commences in youth, and there may be slow progress. (*See also* CHRONIC PERITONITIS, p. 551.) Three groups are described:—

1. ADHERENT PERICARDIUM WITH THICKENING OF MEDIASTINAL TISSUES.—True indurative mediastino-pericarditis.

SYMPTOMS as in adherent pericardium with cardiac hypertrophy: dyspnoea, cyanosis, cardiac failure. 'Mediastinal friction', crackling along sternum on raising arms above head, is ascribed to stretching adhesions. There may also be chronic peritonitis, and the condition be part of a chronic *polyorrhomenitis* (*polyserositis*).

2. PERICARDITIS EXTERNA ET INTERNA.—Pericardium adherent to sternum but mediastinum free.
3. MEDIASTITIS WITHOUT INVOLVEMENT OF PERICARDIUM.

CHAPTER XCIII.

DISEASES OF THE DIAPHRAGM.

I. SPASM OF THE DIAPHRAGM.

Causes of Clonic Spasm (Hiccup).—

1. ALIMENTARY SYSTEM.—(a) Irritation of œsophagus or stomach, e.g., pepper, hot food, gastritis; (b) Dilatation of stomach, peritonitis, intestinal obstruction, ileus; (c) Alcohol (may be central action).
2. NERVOUS SYSTEM.—(a) Central—encephalitis lethargica (may cause epidemic hiccup), cerebral tumour, meningitis, hysteria, uræmia; (b) Peripheral nerves—pericardial effusion, diaphragmatic pleurisy, mediastinal tumour.
3. RENAL.—Chronic nephritis. Uræmia.

Causes of Tonic Spasm.—Tetanus. Strychnine poisoning. Laryngismus stridulus. Rabies.

Treatment.—Simple measures, e.g., holding breath; if persistent, traction on tongue (Hippocrates). Severe forms: antispasmodics and sedatives; finally anæsthesia.

II. PARALYSIS OF THE DIAPHRAGM.

Causes.—

1. LESION OF PHRENIC NUCLEI.—Poliomyelitis, hæmatomyelia, tumours of cord.
2. LESION OF PHRENIC NERVE.—Diphtheria. Neuritis. Pressure of mediastinal tumours. Surgical operations.

Radiographs.—Affected side of diaphragm raised, or paradoxical movement (rises with inspiration). (See also MASSIVE COLLAPSE OF LUNG, p. 583.)

III. EVENTRATION OF THE DIAPHRAGM.

Thinness and weakness of one half of the diaphragm, usually the left, probably congenital, resulting in bulging into the thorax under pressure of the abdominal contents.

Symptoms.—Absent, or resemble DIAPHRAGMATIC HERNIA (q.v.).

Diagnosis.—By radiography.

IV. VARIOUS.

Diaphragmatic Hernia.—(See p. 475.)

Diaphragmatic Pleurisy.—(See p. 603.)

Section VII.—DISEASES OF THE KIDNEY AND URINARY TRACT.

CHAPTER XCIV.

ANOMALIES OF THE URINARY SECRETION.

I. ANURIA.

In anuria, no urine enters the bladder. In retention, the difficulty is to empty the bladder.

Causes.—These are: (1) Obstructive; (2) Non-obstructive.

1. OBSTRUCTIVE.—

a. CALCULUS.—Common form. Calculus blocks one ureter, while other kidney is diseased. More rarely, calculi block both ureters.

b. NEOPLASM, e.g., of bladder, compresses or involves ureters.

2. NON-OBSTRUCTIVE: SUPPRESSION OF URINE.—The causes are miscellaneous:—

a. Nephritis: acute or terminal.

b. Acute fevers (usually temporary; rarely fatal).

c. Following operations on or injuries to the urinary system (from passage of catheter to nephrectomy).

d. Collapse and shock—e.g., hypoglycæmia, cholera.

More rarely:—

e. Hysteria.

f. Poisoning with lead, phosphorus, or turpentine.

Symptoms in Prolonged Anuria.—

1. OBSTRUCTIVE FORMS.—('Latent' or 'asthenic uræmia', Ascoli's uræmia.) Usually no symptoms for several days. May be none until death. Usually slight drowsiness; pupils contracted; low temperature; slight twitchings; occasionally vomiting. Blood-urea rises to 200 mgm. per cent; alkali reserve falls to 30 c.c. CO₂ per cent. Consciousness often until end. Death from cardiac or respiratory failure. Towards end may be ordinary uræmic symptoms. Duration 7 to 12 days or longer.

2. NON-OBSTRUCTIVE FORMS.—Symptoms of ordinary uræmia. in suppression:—

Treatment.—In general, of the causal condition. Special indications

1. To RE-ESTABLISH FLOW.—Distend bladder with warm water. Fluids by mouth. Counter-irritants to kidney, e.g., mustard leaves. Open bowels with salines and enemata.

2. TO REMOVE TOXINS.—Stimulate skin with hot baths or packs, watching pulse for collapse. Rectal or intravenous saline injections.
3. DIURETICS.—When flow recommences. Digitalis (Guy's pill), diuretin, theocine sodium acetate, salyrgan.
- Decapsulation of Kidney.*—In acute nephritis only, within 24 hours of onset. Results doubtful.

II. HÆMATURIA.

The presence of red blood-corpuscles in the urine.

Etiology.—

1. RENAL CAUSES.—

- a. Nephritis. Acute, less commonly in chronic (not in nephrosis). Marked in acute hæmorrhagic nephritis.
- b. Calculus. Hydronephrosis.
- c. New growths: often profuse. Congenital cystic kidneys.

Rarer are:—

- d. Renal infarct (from endocarditis).
- e. Early renal tuberculosis.
- f. Certain poisons—e.g., carbolic acid, cantharides, turpentine.
- g. Angioma and capillary nævi of renal pelvis: usually profuse. Oxaluria may cause slight hæmaturia.

2. AFFECTIONS OF URINARY PASSAGES.—

- a. URETER.—Calculus.
- b. BLADDER.—(i) Neoplasms, papilloma or villous: often profuse. (ii) Calculi: slight. (iii) Bilharziasis: very common in certain countries. (iv) Tuberculosis—rarely.
- c. PROSTATE.—Tumour.
- d. URETHRA.—Calculus or gonorrhœa—rarely.

3. TRAUMA.—(Diagnosis of site of lesion important.)

4. GENERAL DISEASES.—Malignant specific fevers, and malaria. Occasionally in appendicitis.

5. BLOOD DISEASES.—Purpura and hæmorrhagic diatheses, leucæmia, scurvy.

Diagnosis.—Presence of blood in urine recognized by: (1) *Colour*: red or 'smoky'. (2) *Microscopy of deposit*: red cells present: trace of blood thus detected. Chemical test with guaiacum and ozonic ether less reliable. Spectroscope will identify hæmoglobin, but not presence of cells.

'Smoky' tint due to acid salts of urine converting some blood pigment into acid hæmatin and methæmoglobin.

Differential Diagnosis of Cause.—

1. EXAMINATION OF URINE.—

a. APPEARANCE OF URINE.—

Blood profuse: usually calculus or neoplasm.

Colour bright red: bladder or lower urinary tract.

- b. MICROSCOPICAL EXAMINATION.—Examine urine for casts and pus cells; when necessary, also for tubercle bacilli, *Bilharzia* ova.

b. GENERAL CAUSES.—

- i. *Febrile Albuminuria*.—Transient trace common in severe pyrexias and at onset of specific fevers, especially pneumonia, diphtheria, scarlet fever, and typhoid. No subsequent renal changes; differs from true nephritis occurring in later stages of fevers—e.g., in scarlet fever.
- ii. *Blood Diseases*.—Trace often present in severe anæmia, leukæmia, etc.
- iii. *Numerous Diseases*.—Diabetes, syphilis, exophthalmic goitre; Raynaud's and ancillary diseases.

Prognosis.—Depends mainly on the progressive or non-progressive nature, and on other signs of disease—renal, arterial, cardiac, etc. Trace of albumin after middle age needs careful life: prognosis not unfavourable with soft arteries and no casts.

Residual Albuminuria.—Persistence after recovery from attack of nephritis; compared to scar left by wound. Prognosis with great caution, chronic nephritis may appear after many years.

Orthostatic Albuminuria.—Albuminuria of adolescence.

URINE.—Albumin only passed in upright posture, hence not in first morning specimen, but may be present one or two hours later or in evening. Few hyaline casts (but not other forms) and oxalate crystals may be present.

CLINICAL FEATURES.—Usually nervous youths, moist hands, rapid growth (demands on calcium). *Blood-pressure*: (1) Unstable; (2) Not above normal. Heart irritable. *Calcium test*: calcium lactate gr. xv t.d.s. for 3 days abolishes albuminuria (negative result not reliable).

PROGNOSIS.—May cease at puberty or persist. No shortening of life or tendency to nephritis. (Renal efficiency tests advisable.)

PATHOGENESIS.—Theories include: (1) Circulatory disturbance due to vasomotor instability; probable. (2) Mechanical: venous congestion from lordosis; albumin from left kidney only.

V. ALBUMOSURIA.

Of little importance. Occurs with excessive cell destruction—viz., in suppuration, pyrexia, resolving pneumonia, acute yellow atrophy, involution of uterus, and rarely in nephritis, especially syphilitic. Amount rarely large. Presence often masked by concomitant albumin. (For 'Bence-Jones's Albumosuria', see p. 744.)

TEST.—Not precipitated by heat after addition of acetic acid. Cold nitric acid (or better, salicyl-sulphonic acid) causes a precipitate which dissolves on warming and reappears on cooling.

VI. PYURIA.

Presence of pus in the urine.

Principal Causes.—

1. **URETHRA**.—Usually gonococcal. Rarely infections with *B. coli* and other bacteria.
2. **BLADDER**.—(1) Infections with *B. coli*, etc.; (2) Tuberculosis; (3) Calculi; (4) Neoplasms; (5) Prostatitis.

Pyuria—Principal Causes, *continued*.

3. URETER.—Calculus.
4. KIDNEY.—(a) Pyelitis, pyelonephritis, pyonephrosis; (b) Calculus; (c) Tuberculosis; (d) *B. coli* infections.
5. RUPTURE OF EXTRANEOUS ABSCESES.—Prostate, appendix, perinephric, etc. Usually large amount of pus for short time.
6. LEUCORRHOEA.—Few leucocytes.

Test.—Microscopic examination of deposit. (Phosphates, in alkaline urine, dissolve on addition of acid.)

For Bacteriology and Differential Diagnosis, *see* PYELITIS.

VII. LIPURIA.

The passage of urine containing *drops* of fat. Very rare. May occur in: (1) Fractures of long bones; (2) Lipæmia of diabetes; (3) Neoplasms of kidneys.

Urine.—Turbid; drops of fat on surface; *clears with ether*, and fat can be recovered on evaporation of ether. (Beware of oil from catheter or addition of milk by patient.)

VIII. CHYLURIA.

Occurrence.—(1) *Filaria sanguinis hominis*. (2) Non-parasitic; extremely rare; may be obstruction to thoracic duct.

Urine.—Milky appearance. May be blood also. Sometimes clots to a jelly. Rarely drops of fat present.

IX. OXALURIA.

The presence in the urine of an abnormal number of calcium oxalate crystals. This is not necessarily a proof of excessive excretion, but may depend on reaction of urine.

Principles of Excretion of Oxalates and of Oxaluria.—

1. Normal excretion is not more than 10 mgm. *oxalic acid* daily.
2. Deposits form after certain vegetables, especially rhubarb, spinach, strawberries, and tomatoes; but persistence of deposits is pathological, in health there being a trace only.
3. Deposit is never heavy; crystals form on sides of glass; either octahedral or, less commonly, dumb-bell; always calcium oxalate. Urine containing crystals is acid, rarely neutral. (Normally held in solution by acid sodium phosphate.)
4. Oxalic acid excreted is: (a) Mainly exogenous, taken in with the food, either (i) as oxalates, or (ii) from gastro-intestinal fermentation of purins; (b) Partly endogenous, since a trace persists in starvation. Oxalic acid given by mouth is excreted quantitatively.
5. Excretion said to be excessive with increased intestinal fermentation or absence of free HCl from gastric juice.
6. Administration of free HCl increases absorption of calcium oxalate from food and excretion in urine.

Pathological Conditions connected with Oxaluria.—

1. **CALCULI.**—Oxalates (always calcium salt) are commonest constituents of renal and ureteric calculi.
2. **HÆMATURIA AND PYURIA.**—Every other cause must be excluded before ascribing these to oxaluria.
3. **OXALIC ACID DIATHESIS.**—Nervous dyspepsia, general irritability, depression, and neurasthenia, are associated with oxaluria. Symptoms probably depend on metabolic disturbance also causing oxaluria.

Treatment.—Regulate bowels and digestion. Give magnesium, which hinders precipitation—viz., salts, farinaceous foods, beans, and peas. Also acid sodium phosphate and Epsom salts. Avoid calcium foods—e.g., milk, eggs, and oxalate-rich vegetables.

X. CYSTINURIA.

Very rare. Many subjects are children of first-cousin marriages; may be hereditary, but rare. Commoner in males. Continues throughout life, but possibly intermittently.

Symptoms.—No general symptoms, but insolubility leads to formation of calculi.

Calculi.—Large smooth, typical *soapy* feel. Cystin contains sulphur; burns with a blue flame without melting.

Urine.—Colour normal. Contains cystin crystals. Cadaverin and putrescin frequently also present; rarely leucin and tyrosin.

CHARACTERISTICS OF CRYSTALS.—Regular hexagonal plates; soluble in ammonia or HCl, insoluble in water, ether, and acetic acid.

Pathogenesis.—A 'chemical malformation' (Garrod) of amino-acid metabolism. A cystinuric usually metabolizes ingested cystin to sulphate, as do normal men; hence excreted cystin arises from protein of tissues and not of food; exceptions to this occur.

XI. PHOSPHATURIA.

Generally applied to deposit of phosphates in urine. Excretion not necessarily increased; nor does an increased secretion necessarily, or even usually, lead to a deposition.

General Principles of Excretion and Precipitation of Phosphates.—

1. Phosphates are excreted as : (a) Alkaline phosphates, sodium and potassium; never precipitated as such; form three-fourths. (b) Earthy phosphates, calcium and magnesium; only soluble in acid urine; form one-fourth. Total: 2 to 5 grm. daily.
2. Origin : (a) Exogenous, from food; (b) Endogenous, from nuclear tissue (nuclein, lecithin).
3. Precipitate of phosphate, soluble on adding acid, forms on heating urine even if acid; this is due to decomposition of two molecules of calcium hydrogen phosphate into one of mono-calcium hydrogen phosphate and one of tricalcium phosphate ($\text{Ca}_3(\text{PO}_4)_2$), latter being comparatively insoluble in water.

Phosphaturia—Excretion and Precipitation of Phosphates, *continued*.

4. Physiological phosphaturia occurs after meals ('alkaline tide'), due to gastric secretion of HCl: especially after rich protein meals, or with quantity of vegetables. Results from increased excretion of 'fixed alkali' (sodium, potassium salts).
5. Phosphates deposit in presence of 'volatile alkali', viz., ammonia.
6. Nature of precipitate:—
 - a. 'Triple phosphate': ammonium magnesium phosphate.
Shape: 'coffin lid'; in very alkaline urine, feather- or fern-shaped.
 - b. 'Stellar phosphate': calcium hydrogen phosphate.
Shape: long flat prisms, often in bunches; may occur in slightly acid urine. Rare in health: occurs in diabetes and cachexia.
 - c. Amorphous phosphates: calcium and magnesium phosphates.

Pathology of Phosphate Sediments.—

1. IN ALKALINE URINES.—Importance depends on primary cause, e.g., cystitis; in this, ammonia is due to bacteria decomposing urea.
2. IN NERVOUS DISORDERS, especially of sexual organs.—Often passed at end of micturition and mistaken for spermatozoa. Little-known condition.
3. IN CHILDREN.—Calcium in urine increased: probably an error of intestinal mucous membrane preventing normal excretion by the colon.

XII. INDICANURIA.

Indican is a compound, formed in the tissues, of potassium sulphate with indoxyl, derived from indole, a product of bacterial fermentation of proteins. With strong acids, indican oxidizes to indigo, thus forming purple ring in urine floating on nitric acid: depth of ring is approximate guide to quantity: usually a trace.

EXCESS suggests increased intestinal fermentation. Occurs in constipation, mental depression, and occasionally in empyemata and unopened abscesses.

XIII. BLACK URINES. MELANURIA.

Urine may be clear on passage, and become dark on standing. All forms of *black* urine are rare. Dilution of urine often gives guide to cause. Very dark urine may occur in:—

1. **JAUNDICE**.—Only if very excessive.
2. **HÆMOGLOBINURIA**.—May be extremely dark; on dilution tint is red.
3. **HÆMATURIA**.—Rarely very dark; on dilution tint is red.
4. **HÆMATOPORPHYRINURIA**.—May be extremely dark; on dilution tint is red.
5. **DRUGS**.—Especially resorcin. Also carbolic acid ('carboloria': colour due to hydroquinone).
6. **BERRIES**.—Dark cherries, etc. Colour rarely very marked.

In the following, colour develops on standing :—

7. MELANURIA.—On standing, or addition of ferric chloride. Confined to melanotic sarcoma. Colour is *black*: true melanuria.
8. ALKAPTONURIA.—On standing, or addition of alkali.
9. INDICANURIA.—*Very rarely* is sufficient to darken urine.

XIV. ALKAPTONURIA.

Due to excretion in urine of 'alkapton', homogentisic acid (hydroquinone-acetic acid). A harmless congenital 'chemical malformation' (Garrod), metabolism of tyrosin being arrested at a certain point.

Characteristics.—

1. Often several members of family ; not hereditary ; consanguineous marriage frequent.
2. Dates from birth ; noticed by staining of linen ; commoner in males.
3. No symptoms or effect on health, except *ochronosis*.
4. *Urine*, normal when passed, darkens on standing or addition of alkali.

Reduces Fehling, but optically inactive, and does not ferment.

Drop of ferric chloride produces transient deep blue colour.

5. Tyrosin increases output: in normal persons has no effect. No treatment necessary or effectual.

Note.—The statement formerly made that another acid, uroleucic acid, was also present, was based on a misapprehension.

Ochronosis.—Blackening of cartilages and fibrous tissue occurring from (1) alkapton, (2) derivative of carbolic acid. Visible on knuckles, superficial tendons, conjunctiva, ears, and sometimes skin of nose and cheeks. No symptoms except arthritis with curious 'goose-gait'.

XV. PNEUMATURIA.

Passage of gas with urine. Occurs in :—

1. **Gas-forming Organisms in Bladder**.—Usually introduced by catheter. Most common is *yeast fungus*, with *glycosuria*.
2. **Vesico-enteric Fistula**.

XVI. HÆMATOPORPHYRINURIA.

Etiology.—Almost confined to females.

1. **CONGENITAL**.—"An inborn error of metabolism" (Garrod).
2. **ACQUIRED**.—(a) *Acute*: usually due to sulphonal, rarely trional; in a few cases, no drugs. (b) *Chronic*.

Nature of Pigment.—Forms portion of hæmoglobin molecule; akin to iron-free hæmatin. Intermediate between hæmoglobin and bilirubin. Probably not entirely derived from blood: hence name 'porphyrinuria' is suggested.

Hæmatoporphyrinuria, continued.

Symptoms.—In acute drug cases: rapid toxæmia occurs (withhold drug and give alkalis); rarely in non-drug cases. In chronic and congenital forms: hydroa æstivale may develop (due to loss of protecting pigment); duration of life appears to be shortened, but without other symptoms; teeth and bones may be stained pink.

URINE.—Usually deep port-wine colour on passage. Occasionally brown, if pigment is combined with metal. Does not give blood tests. No protein present. Spectrum: complex and characteristic, but in metallic form resembles oxyhæmoglobin; is freed by acid. Colour is not due to hæmatoporphyrin—for this is colourless in urine, and after its removal urine remains black—but to some unknown pigment which accompanies it.

XVII. COLOURED URINES.

Blue urine is invariably due to methylene blue; also

Green urine, except for special dark-green tint occasionally seen in jaundice.

Other drugs affecting colour include: Eosin (used in sweets): pink. Pyramidon: reddish-orange (if acid). Santonin: yellow, pink if alkaline. Senna, rhubarb: reddish-brown, pink if alkaline.

XVIII. OTHER SUBSTANCES.

Glucose, Acetone (*see* DIABETES), **Bile** (*see* JAUNDICE). **Leucin** and **Tyrosin** (*see* ACUTE YELLOW ATROPHY).

CHAPTER XCV.

TESTS OF RENAL EFFICIENCY.

Numerous tests of renal function are now being studied. This applies to nephritis, eclampsia, and surgical diseases of the genito-urinary tract. *No single test is reliable*, except in extreme instances. Two or preferably three should be performed, and considered in conjunction with clinical manifestations. Cardiac failure will influence any of the tests.

1. Specific Gravity.—(1) If specific gravity is within normal limits, 1018 to 1025, in 24 hours' specimen, and daily amount of urine is normal under ordinary conditions, serious renal inefficiency is very improbable. Remains a valuable test. (2) Normal kidney secretes dilute urine (low specific gravity) after ingestion of a large amount of fluid, and concentrated urine (high specific gravity) after little fluid and dry food, i.e., specific gravity varies greatly during 24 hours. As a kidney progressively fails, it has

to work continuously at maximum output to clear blood of waste products. In final stages, specific gravity is 1010 to 1012 and urea about 0.9 per cent in all specimens throughout 24 hours: no alteration produced by food or fluid. A valuable test of advanced renal deficiency. Is basis of many tests.

2. Blood Urea.—In certain renal disturbances, urea is retained in the blood. Is very valuable test, but note:—

- a. Retention does not occur until at least three-fourths of kidney is inefficient.
- b. High blood urea may be due to extra-renal causes—e.g., shortage of fluid or diarrhoea, alkalosis, cardiac failure, suppuration. In these conditions urinary urea is high.
- c. Reduced diet will lower blood urea, but this is no evidence of improvement. In uræmia it may become normal and death still occur.

NORMAL.—Urea 15 to 40 mgm. per 100 c.c. of blood (0.015 to 0.040 per cent). The higher figures apply to later life. Over 50 mgm. is evidence of disturbed renal function.

SURGICAL DISEASES OF GENITO-URINARY TRACT.—Test is of value, especially when considered with 'urea concentration factor'. If over 80 mgm., operation is dangerous.

NON-PROTEIN NITROGEN (N.P.N.).—Uric acid, creatinin, and purin bodies besides urea may be retained in body, and together estimated as 'non-protein nitrogen'. Preferred by some authorities to estimation of urea alone. Results agree.

3. 'Urea Concentration Test' (MacLean and de Wesselow).—Reveals slighter lesions than blood urea. Method: Administration of 15 gm. of urea in 100 c.c. of water, patient emptying his bladder just previously. At end of one, two, and three hours, urine is passed and the urea estimated. If urea is 2 per cent or over, the kidney is acting efficiently. If below this percentage, the kidney action is deficient, roughly proportional inversely to the percentage of urea.

Amount of urine must not exceed 120 c.c. Very little fluid must be taken for 12 to 18 hours before test. Diuresis, due to urea, otherwise may occur, and in such case results are not necessarily evidence of renal inefficiency.

'UREA CONCENTRATION FACTOR'.—Found by comparison of blood urea with urine urea, i.e., test of concentration by kidney. Normal concentration is 70 to 100 times. Valuable in surgical conditions.

NOTE.—This valuable pioneer test is largely superseded by water elimination and urea clearance tests.

4. Urea Clearance Test (van Slyke).—Designed to measure "number of c.c. of blood per minute cleared of urea by renal excretion". No food for two hours previously: collect urine over two periods of one hour. Estimate blood urea in mid-stage.

Renal Efficiency—Urea Clearance Test, *continued*.

- a. MAXIMUM CLEARANCE (C_m).—When excretion is more than 2 c.c. per minute:—

$$\text{Clearance} = \frac{U}{B} V$$

where U = urine urea; B = Blood urea in mgm. per cent; V = volume of urine in c.c. per minute.

Average Normal.—75 c.c.

- b. STANDARD CLEARANCE (C_s).—When excretion is less than 2 c.c. per minute:—

$$\text{Clearance} = \frac{U}{B} \sqrt{V}$$

Average Normal.—54 c.c.

CALCULATION.—Result is expressed in percentage of normal average, e.g., C_s of 36 c.c. is expressed as $\frac{36 \times 100}{54} = 66$ per

cent of normal. Below 70 per cent indicates renal deficiency. Uræmia occurs below 5 and not above 10 per cent. Figures below normal may be due to: (i) Diminished blood-flow through kidneys—e.g., heart disease; (ii) Diminished renal clearance—e.g., nephritis, alkalosis.

NOTE.—Repetition of test in same subject gives considerable variations, and Addis's modification is more reliable.

ADDIS'S MODIFICATION.—Fluid diminished for 12 to 18 hours previously. No food in morning. Give 15 gm. urea in 100 c.c. water. Collect urine over three periods of one hour. Estimate blood-urea at end of second hour. Calculate clearance on mean of second and three-hour specimens.

Average Normal.—72 c.c. Below 50 c.c. indicates renal deficiency.

5. **Water Concentration Test (Volhard).**—Dry diet for 24 hours with fluid total 400 c.c. Urine collected as passed. Total amount normally 300 to 750 c.c., not exceeding latter. Specific gravity from 1020 to 1030, one portion at least 1025. (Elimination Test (see below) is preferable.)

6. **Water Elimination Test (Volhard).**—No fluid overnight. Collect urine in morning. Then give 20 to 30 oz. of water. Collect urine in one, two, three, and four hours. Estimate volume, specific gravity, and urea.

NORMAL.—(1) Fluid taken is excreted in 3 to 4 hours. (2) High urea in morning specimen; low after fluid (1002).

ABNORMAL.—(1) Proportion of fluid only excreted in 3 to 4 hours. (2) Specific gravity and urea about the same in all specimens.

This test avoids administration of urea. Is very valuable.

7. **Phenolsulphonephthalein Test.**—Subject drinks a glass of water and empties the bladder; 1 c.c. of standard solution of dye injected into lumbar muscles. Bladder emptied again one and two hours later. Amount of dye passed estimated quantitatively

with Duboscq colorimeter. Normally 70 per cent in two hours. Under 50 per cent is evidence of renal inefficiency. None may appear. Efficiency also measured by time of appearance of dye: normally commences in 5 to 10 minutes, delay beyond 10 minutes is abnormal. Ureters may be catheterized.

Difficulties arise from presence of blood, urinary pigments, and technique of estimation, but results satisfactory to many workers.

8. Indigo-carmin Test.—Only employed in surgical conditions, for testing relative working of each kidney. Inject intravenously 2 c.c. of 0.4 per cent solution. Blue urine should appear in 7 minutes.

9. Plasma Globulin and Albumin.—Estimation of value in œdema (see CAUSES OF ŒDEMA, p. 632).

CHAPTER XCVI.

CLASSIFICATION AND GENERAL CONSIDERATION OF NEPHRITIS.

Classification.—Based on Volhard and Fahr, and on Elwyn.

A. GLOMERULO-NEPHRITIS.—*Inflammatory.*

1. ACUTE.—

a. Acute focal (Volhard). (Acute hæmorrhagic nephritis.)

b. Embolic focal.

c. Acute diffuse. (Acute parenchymatous nephritis.)

Intermediate Stages.—

b. Chronic active stage.

a. Latent stage. Silent stage.

} See COURSE OF ACUTE
GLOMERULO-NEPHRITIS,
p. 636.

2. SUBACUTE AND SUBCHRONIC DIFFUSE (Large white kidney).—

a. Subacute. Extra-capillary type (Volhard).

b. Subchronic. Intra-capillary type.

3. CHRONIC.—

a. Secondary small white kidney.

b. Primary small white kidney.

B. NEPHROSIS: DEGENERATIVE TUBULAR NEPHRITIS.—

Degenerative.

a. Lipoid: (i) Cryptic; (ii) Toxic (syphilis).

b. Toxæmia of pregnancy.

c. Amyloid disease.

d. Necrotizing nephrosis (bichloride of mercury, etc.).

C. NEPHROSCLEROSIS: ARTERIOSCLEROTIC BRIGHT'S DISEASE (Chronic interstitial nephritis).—*Vascular.*

a. Senile kidney.

b. Arteriosclerotic kidney. Kidney of benign hypertension.

c. Red granular contracted kidney. Kidney of malignant hypertension.

Nephritis—Classification, continued.

Group A, glomerulo-nephritis, may also well be termed glomerulo-tubular nephritis, since the tubules show (secondary) changes in all forms except acute focal.

The terms 'large' and 'small white kidney', and 'red granular kidney' are here used to describe clinical groups and without intending to emphasize the colour found at autopsy. Redness or pallor is often mainly due to presence or absence of cardiac failure.

The term 'chronic interstitial nephritis' is still in use, but misleading; it would also apply to advanced grades of chronic glomerulo-nephritis.

For 'acute interstitial nephritis', see p. 646.

Summary of Characteristics.—**A. GLOMERULO-NEPHRITIS.—**

ESSENTIAL SYMPTOM.—Hæmaturia.

PATHOGENESIS.—Related to septic infections.

INITIAL LESION.—Inflammation of glomeruli.

SECONDARY LESIONS.—Degeneration of tubules (œdema).

Inflammatory proliferation of Bowman's capsule. Varying degree of small-cell infiltration of interstitial tissues.

Hypertrophy of unaffected nephrons.*

CHRONIC STAGES (varying with duration).—Atrophy of affected nephrons. Fibrosis and contraction. Vascular changes.

COURSE.—Renal insufficiency: very variable.

B. NEPHROSIS.—

ESSENTIAL SYMPTOM.—œdema and gross albuminuria.

PATHOGENESIS.—No relation to sepsis. Possibly toxic.

INITIAL LESION.—Degeneration of tubules.

CHRONIC STAGES.—Slight changes as in glomerulo-nephritis, or none.

COURSE.—Recovery or secondary complications.

C. NEPHROSCLEROSIS: ARTERIOSCLEROTIC BRIGHT'S DISEASE.—

ESSENTIAL SYMPTOMS.—Cardiovascular. Hypertension.

PATHOGENESIS.—Uncertain.

INITIAL LESION.—Degeneration of arterioles.

CHRONIC STAGES.—General atrophy, fibrosis, and contraction.

COURSE.—Cardiovascular features and failure.

Various Synonyms.—Confusion is caused by numerous terminologies in use. The following table gives certain synonyms used by various authorities. Some of the principles on which recent classifications have been based are discussed subsequently.

ACUTE HÆMORRHAGIC NEPHRITIS.—

SYNONYMS.—Acute non-embolic focal nephritis or glomerulo-nephritis. Acute parenchymatous nephritis. Essential hæmaturia. (Not in Russell's classification.)

* Nephron = a glomerulus and its tubules.

ACUTE DIFFUSE GLOMERULO-NEPHRITIS.—

SYNONYMS.—Acute diffuse nephritis or glomerulo-tubular nephritis. Acute nephritis. Acute parenchymatous nephritis. Nephritis acris, early stage (Russell).

SUBACUTE AND SUBCHRONIC GLOMERULO-NEPHRITIS.—

SYNONYMS.—Subacute and subchronic glomerulo-tubular nephritis. Chronic parenchymatous nephritis. Large white kidney (excluding nephrosis). Hydræmic nephritis. Nephritis acris, more chronic stages; and partly nephritis mitis (Russell).

SECONDARY SMALL WHITE KIDNEY.—

SYNONYMS.—Chronic glomerulo-nephritis or chronic glomerulo-tubular nephritis. Chronic parenchymatous nephritis. Hydræmic, azotæmic, or mixed nephritis. Nephritis acris, chronic stage, and nephritis repens, Types 1 and 2 (Russell).

PRIMARY SMALL WHITE KIDNEY.—

SYNONYMS.—Chronic diffuse glomerulo-nephritis. Bradford's kidney. Azotæmic nephritis. Renal dysbiotrophy. Nephritis repens, Type 3 (Russell).

NEPHROSIS.—

SYNONYMS.—Degenerative tubular nephritis. Hydræmic or hydropigenous nephritis. Nephritis mitis (Russell). Formerly included under large white kidney and chronic parenchymatous nephritis.

ARTERIOSCLEROTIC KIDNEY.—

SYNONYMS.—Essential hyperpiesis. Gull and Sutton's arterio-capillary fibrosis. Chronic interstitial nephritis. Benign arteriolo-sclerosis (Fahr). Primary ischæmic nephritis (Russell).

RED GRANULAR CONTRACTED KIDNEY.—

SYNONYMS.—Chronic interstitial nephritis. Malignant arteriolo-sclerosis (Fahr). Ischæmic nephritis (Volhard). Azotæmic nephritis. Nephritis repens, Type 4 (Russell).

Notes.—

ACUTE PARENCHYMATOUS NEPHRITIS.—Now subdivided clinically and pathologically into (a) acute hæmorrhagic nephritis, and (b) acute diffuse glomerulo-nephritis.

CHRONIC PARENCHYMATOUS NEPHRITIS.—Now subdivided clinically and pathologically into (a) nephrosis, and (b) large white and secondary small white kidney (subacute, subchronic, and chronic glomerulo-tubular nephritis).

Russell's classification is based on post-mortem material, and is clinically incomplete.

Pathological Changes and their Correlation with Clinical Symptoms and Types of Nephritis.—The three main types of tissue in the kidney are: (1) Glomeruli; (2) Tubules; (3) Blood-vessels and vascular structures.

German investigators especially have attempted to correlate symptoms and types of nephritis with pathological changes in the separate structures.

I. GLOMERULI AND HÆMATURIA.—Hæmaturia in nephritis always comes from glomeruli (Loehlein, Fahr, and others).

Types of Nephritis in Relation to Pathological Changes, *continued*.

Glomerulitis is initial and essential lesion in all types classified as glomerulo-nephritis. Two types of glomerulitis are separated:—

- a. FOCAL.—Only some glomeruli affected and only some loops of an affected glomerulus. Sufficient blood still passes to the afferent vessel supplying the related tubule, which thus remains unaffected. This form is acute focal glomerulo-nephritis or acute hæmorrhagic nephritis; formerly included in acute parenchymatous nephritis. (Also minor form, 'embolic'.)
- b. DIFFUSE.—All glomeruli affected and all loops. Deficient blood-supply results in disease of the tubules. This form is acute diffuse glomerulo-nephritis or glomerulo-tubular nephritis; formerly known as acute parenchymatous nephritis.

Volhard believes: (i) The two types are entirely distinct; (ii) Focal form is purely monosymptomatic, i.e., hæmaturia only, any œdema placing case in *diffuse* group; (iii) Prognosis in focal form nearly always good, and in diffuse form bad.

Strict differentiation of the two types is not universally accepted, but the general principles accord with clinical observations.

2. TUBULES AND ŒDEMA.—

- a. NEPHROSIS.—Muller and Munk found cases of nephritis in which sole appreciable change was *degeneration of tubules* (assumed to be primary). Munk and Volhard showed that this change was associated with œdema, œdema being thus correlated with disease of tubules. 'Nephrosis' thus separated from former type of 'large white kidney'.
- b. NEPHROTIC TYPES AND STAGES.—Inflammation of capillaries of tuft (i.e., glomerulitis) interferes with and diminishes blood in the efferent artery of tuft: this supplies corresponding tubule of the nephron. *Degeneration* of tubules of secondary origin may thus occur in glomerulo-nephritis, or in some cases it may be *inflammation* of tubules. Œdema thus results: may be coincident with hæmaturia, but glomerulitis may considerably subside in course of progress and œdema thus come to exist without hæmaturia—viz., nephrotic type or stage of glomerulo-nephritis.

Œdema in these types is mainly due to low plasma-protein following drain by albuminuria. It is *not* directly produced by disease of tubules.

3. VASCULAR STRUCTURES.—Changes in the blood-vessels are associated with rise in blood-pressure.

Correlation of Biochemical Changes with Clinical Symptoms and Types of Nephritis (French Classification).—Two types of chronic nephritis distinguished by biochemical differences (Widal and Strauss): (1) Hydræmic or hydropigenous—characterized by retention of chloride; (2) Azotæmic—characterized by retention of nitrogen.

SUMMARY OF DIFFERENCES.—

	<i>Hydræmic</i>	<i>Azotæmic</i>
1. Edema	Present ..	Absent
2. Cardiovascular changes.. ..	Absent or slight	Marked
3. Albumin	Marked ..	Slight : may be absent
4. Chlorides in urine	Trace or absent	Normal
5. Urea concentration	Normal ..	Diminished
6. Blood urea ..	Normal ..	Increased
7. Uræmic symptoms	Unusual	Common
8. Cholesterolæmia ..	High ..	Normal

HYDRÆMIC TYPE.—Corresponds approximately to nephrosis and nephrotic stages of large white kidney and small white kidney.

THEORY.—Retention of chloride results in increase of chloride in plasma, then increase of fluid in blood for dilution, and œdema as result of hydræmia. (*See CAUSES OF ŒDEMA*, p. 632.)

AZOTÆMIC TYPE.—Corresponds approximately to red granular contracted kidney, and to late contracting stages of small white kidney.

THEORY.—Retention of nitrogenous waste products produces toxic action and uræmia.

Difficulty arises from numerous mixed types, and alterations from one type to the other in a given case, e.g., in course of large white kidney. British, American, and German authorities in general do not accept French views on chlorides, but these lately have been skilfully developed and need careful consideration.

British authorities have frequently used the two terms 'azotæmic' and 'hydræmic' on the criteria of the retention or non-retention of nitrogen respectively. This omits reference to sodium chloride, considered an essential feature by French workers.

CHAPTER XCVII.

RENAL INSUFFICIENCY AND URÆMIA.

RENAL INSUFFICIENCY.

Structural damage to kidneys of a certain degree manifests itself by defects in renal secretion, which result in renal insufficiency.

DEFECTS EXHIBITED BY.—

1. DEFICIENCY IN POWER OF CONCENTRATION.—

a. Affects every constituent of urine, normal or abnormal, e.g., glucose.

b. A substance is affected in proportion to the degree in which it is normally concentrated.

Thus urea and chloride are affected simultaneously, but urea being present in greater amount is earlier noticeable.

2. DEFICIENCY OF RESPONSE TO INCREASED WORK.—E.g., test doses of urea or water.

Renal Insufficiency, *continued*.

RESULTS.—

1. Accumulation in body of urea and end-products of metabolism.
2. Interference with hydrogen-ion concentration of blood, producing acidosis or alkalosis.
3. Urine gradually reaches a fixed composition, corresponding to maximum powers of kidney. In last stages before renal failure, specific gravity is about 1000 (isotonic with serum) and cannot artificially be made to vary.

ACIDOSIS.—End-products of metabolism are commonly acid. Retention causes increased hydrogen-ion concentration of blood—i.e., acidosis—resulting in: fall of CO_2 in alveolar air, and diminished absorption of oxygen into blood. *Dyspnoea* hence occurs.

ALKALOSIS.—Results if end-products of metabolism are alkaline. Alkali reserve rises. Blood calcium falls. Produces *twitching* and other symptoms.

URÆMIA.—Manifestation of renal failure in excessive renal insufficiency.

RISE IN BLOOD UREA.—Develops in:—

1. **ORGANIC RENAL DISEASE.**—May occur in any form: acute or chronic nephritis, amyloid kidney, tuberculous, cystic, or calculous kidneys; hydronephrosis; anuria from calculi, etc., or following operations on the urinary system. Not in pure nephrosis.
2. **DIMINISHED BLOOD-FLOW THROUGH THE KIDNEYS.**—As in cardiac failure; blood urea may rise to 100 mgm. per cent, but not appreciably above.
3. **ALKALOSIS.**—Mode unknown, possibly inhibits renal activity: may be no organic renal disease. Blood urea may rise to 400 mgm. per cent or more.

URÆMIA.

A group of symptoms associated with failure of renal function, usually but not invariably with rise of blood urea. Formerly believed to result from organic disease of the kidney; indistinguishable symptoms can occur in absence of such disease.

It is now recognized that the clinical picture known as uræmia consists of several groups of symptoms, caused by different factors, which may coexist or overlap, or one of which may set up a vicious circle producing others of the factors. Uræmia is thus a complex manifestation. Knowledge is incomplete but advancing.

Theories of Origin and Factors Concerned (provisional).—

1. **TOXÆMIA DUE TO RETENTION IN BLOOD OF UREA AND OTHER NITROGENOUS WASTE PRODUCTS.**—

Chronic uræmia does not occur with blood urea under 150 mgm. per cent, though convulsive uræmia may do so.

OBJECTIONS.—(a) Urea administration said not to cause uræmia (now known to do so if in large doses); (b) Urea

retention exists without uræmia (but rarely for long above 150 mgm. per cent)—e.g., in cardiac failure, blood-urea may rise to 100 mgm. per cent, or slightly above, but by itself is not associated with chronic uræmia; (c) Uræmia (but not chronic uræmia) occurs without urea retention; (d) Complete anuria produces different symptoms (*see* p. 612).

Retention is not a complete explanation, but is a factor.

2. **CEREBRAL ŒDEMA.**—Productive of *acute convulsive uræmia* occurring in nephritis with œdema. Exciting factor is rapid rise of blood-pressure above previous level. Is a form of hypertensive encephalopathy. Manifestations: headache, convulsions, amaurosis, coma; may be vomiting. Blood-urea not necessarily raised: but is so if *chronic uræmia* also present.
3. **CEREBRAL VASCULAR SPASM.**—Cause of transient pareses associated with arteriosclerosis, acting by cerebral ischæmia: Volhard's *chronic pseudo-uræmia*. Exciting cause is rapid rise of blood-pressure above previous level. Is a form of 'hypertensive encephalopathy'.
4. **DISTURBANCE OF HYDROGEN-ION CONCENTRATION AND OSMOTIC PRESSURE OF BLOOD.**—Are known to occur in renal deficiency, either acidæmia (whence dyspnœa and respiratory symptoms of uræmia) or alkalæmia (whence low calcium content and twitching). Factors are complex (*see* ALKALOSIS).

ADDITIONAL FACTORS.—

ANÆMIA.—Hæmoglobin is a buffer in maintaining pH of blood constant.

BLOOD CALCIUM.—If diminished, aids twitching and tetanic symptoms.

ALKALOSIS.—May produce symptoms indistinguishable from chronic uræmia in absence of nephritis, i.e., '*pre-renal uræmia*' (Langdon-Brown), or act as additional factor, or may injure kidney and produce vicious circle.

DISTURBED METABOLISM.—Influence of many substances unknown, e.g., rise of blood cholesterol, variations of blood chloride, presence of trimethylamine.

HYPERTENSIVE ENCEPHALOPATHY (Fishberg). — *Hypertensive cerebral attacks*. Term applied to cerebral manifestations in an attack of hypertension, viz., rapid rise of blood-pressure above previous level. Includes: (1) Cerebral œdema in glomerulo-nephritis; (2) Cerebral spasm in arteriosclerosis; (3) Encephalopathy in acute lead poisoning; (4) Eclampsia.

Types of Uræmia.—

1. **ACUTE CONVULSIVE URÆMIA.**—*Synonyms*: Volhard's acute pseudo-uræmia. Hypertensive encephalopathy.
2. **CHRONIC (TRUE) URÆMIA.**
3. **PSEUDO-URÆMIA.**—*Synonyms*: Volhard's chronic pseudo-uræmia. Hypertensive encephalopathy.
4. **LATENT URÆMIA.**—*Synonyms*: Asthenic uræmia. Ascoli's urinæmia.

Uræmia, *continued*.

1. Acute Convulsive Uræmia.—

OCCURS IN.—Acute diffuse glomerulo-nephritis. Chronic diffuse glomerulo-nephritis, viz., in oedematous stages. Nephrosis. Not in acute hæmorrhagic nephritis. In chronic uræmia, acute convulsive may also occur.

SYMPTOMS.—Entirely cerebral. May be vomiting and bradycardia.

EPILEPTIFORM CONVULSIONS.—Onset (i) abrupt, or (ii) preceded by headache and restlessness. Fits usually general, resemble epilepsy (cry rare), and may recur rapidly. Unconsciousness invariable during general convulsion: also usually in intervals when recurrent, but may be incomplete. Temperature usually low, but may rise.

AMAUSIS.—May follow convulsions, viz. blindness, without retinal changes or with albuminuric retinitis.

COMA.—May follow convulsions.

BLOOD UREA.—Usually but not always raised: rarely over 100 mgm. per cent. (Cardiac weakness is a factor.)

BLOOD-PRESSURE.—Raised temporarily at time of attack but not necessarily permanently.

BLOOD CHOLESTEROL.—High. (Relation doubtful.)

COURSE AND PROGNOSIS.—Prognosis grave. May be fatal during convulsions or coma following. Recovery not uncommon in acute nephritis and nephrosis, but rare in chronic forms and when associated with chronic uræmia.

MORBID ANATOMY.—Brain bulky. Cerebrospinal fluid under pressure.

TREATMENT.—

SWEATING.—Induced by hot packs and hot-air baths. (Temperature 120° F. for 15 minutes: watch pulse.)

BLOOD-LETTING.—Remove about 20 oz. (unless definite anæmia): saline 10 oz. may be injected.

MORPHIA INJECTION.

MAGNESIUM SULPHATE.—By mouth. If fits recur, either (a) Intramuscular, 25 per cent solution, 0.2 c.c. per kilo weight; or (b) Intravenous, 2 per cent solution, 1 c.c. per kilo (3 c.c. per minute); or intravenous injection of 40 c.c. of 30 per cent sodium chloride may be substituted.

LUMBAR PUNCTURE (if headache severe).—Withdraw fluid very slowly, 10 to 20 c.c. if pressure high: risk of impaction of medulla.

Other measures include:—

SALINE ENEMATA.

FOR ACIDÆMIA.—Alkalis by mouth or intravenously, viz., sod. bicarb. 2 per cent, 200 to 400 c.c.; effect transient.

2. Chronic Uræmia (True Uræmia).—

OCCURS IN.—Chronic nephritis with blood urea over 150 mgm.

ONSET.—Generally insidious. Headache, vomiting, twitching of muscles, restlessness, insomnia. Retinitis. Occasionally onset acute.

SYMPTOMS.—Three principal groups: usually coexist. Cerebral symptoms almost invariably present before death.

1. **CEREBRAL.**—(a) Headache, early and often severe; lack of concentration. (b) Numbness and tingling of fingers. (c) Twitching of muscles. (d) Cramps in muscles, especially calves. (e) Itching of skin. (f) Persistent insomnia; may continue until death with few other symptoms. (g) Transient and local paralyses; any form of hemiplegia or monoplegia may occur.
2. **GASTRO-INTESTINAL.**—Vomiting (may be uncontrollable), nausea, and hiccups. Constipation or diarrhoea. Vomiting sometimes only follows food and is mistaken for dyspepsia.
3. **RESPIRATORY.**—*Dyspnoea*. Breathing noisy. May be continuous, or nocturnal, or—
Cheyne-Stokes Respiration.—With coma is of grave prognosis. In alveolar air, CO_2 falls to 3 per cent or under, instead of normal 5 per cent.

SYMPTOMS OF ACUTE CONVULSIVE URÆMIA.—May be added (if œdema also present): viz., epileptiform convulsions, amaurosis.

COMA.—Usually terminates other symptoms. Gradual or rapid onset. Tongue furred. Breath heavy. Pupils contracted. Knee-jerks increased. Temperature subnormal. May last several days, rarely longer.

ACUTE MANIA.—May occur without warning. Usually ends in coma.

DELUSIONAL INSANITY ('folie brightique').—Nephritis often unsuspected, found at autopsy.

BLOOD URÆA.—Over 150 mgm. per cent.

BLOOD-PRESSURE.—High.

BLOOD CHOLESTEROL.—120 to 300 mgm. per cent.

BLOOD CALCIUM.—May fall to 6 mgm. per cent.

WASTING.—May be masked by œdema.

TEMPERATURE.—Subnormal.

SKIN.—A deposit of urea may form ('urea frost'). Rare.

COURSE AND PROGNOSIS.—Always serious. May be:—

1. *Temporary* improvement. Symptoms in milder grades may continue for days or weeks ('pre-coma'), and then improve.
2. Coma: always fatal.
3. Terminal infections and exudations: e.g., pericarditis, pleurisy. Rarely peritonitis, meningitis.

SUMMARY OF SYMPTOMS IN CHRONIC URÆMIA.—

EARLY STAGE.—Headache. Sleeplessness. Nausea and vomiting. Tingling of fingers. Slight twitching of muscles. Cramps in calves. Breath heavy. Tongue furred. Pupils contracted.

PROGRESSING.—Severe vomiting. Paroxysmal dyspnoea. Various paralyses.

LATE STAGE.—Cheyne-Stokes breathing. Epileptiform convulsions. Death in coma.

DIAGNOSIS.—(See COMA, p. 314.)

Chronic Uræmia, continued.

TREATMENT.—Of little avail. In early stage:—

BLOOD-LETTING AND INJECTION OF SALINE.

MORPHIA.—For restlessness, insomnia, or delirium. Also for fits.

RECTAL SALINE AND GLUCOSE.—Saline aperients (avoid diarrhoea)

FOR TWITCHINGS.—Inject calcium (treat as tetany). Trinitrinum if blood-pressure high.

COMA.—Treatment useless: try blood-letting.

3. Pseudo-Uræmia.—Associated with arteriosclerosis and high blood-pressure (*see* HYPERTENSIVE ENCEPHALOPATHY). Attributed to cerebral vascular spasm causing transient cerebral ischæmia. Local and transient paralyses: any form of hemiplegia or monoplegia. May last only a few minutes to a few hours and recovery be complete. Often recurs. Blood urea not always raised. *Treatment:* Venesection. Definite cerebral hæmorrhage is liable to occur.

4. Latent Uræmia.—(*See* p. 612.)

CHAPTER XCVIII.

CAUSES OF ŒDEMA.

Œdema in Nephritis.—

OCCURS IN: (1) Acute nephritis; (2) Subacute, subchronic, and chronic glomerulo-nephritis; (3) Nephrosis; (4) Cardiac failure complicating nephritis.

ABSENT OR SLIGHT IN nephritis with mild albuminuria: nephrosclerosis, acute hæmorrhagic nephritis.

Amount of Protein in Œdema Fluids.—

	Per cent
Acute nephritis œdema	1.0
Nephrosis œdema	0.1
Chronic nephritis œdema, nephrotic types	0.03 to 0.05
Chronic nephritis transudates	0.5
Cardiac œdema	5 to 7 (i.e., as in plasma)
Œdema due to dilatation and injury to capillaries —e.g., inflammatory œdema, urticaria, snake-bite, histamine poisoning	

Factors governing Transudation and Absorption of Fluids.—

Principal factors thus controlling œdema are: (1) Permeability of capillary endothelium; (2) Capillary pressure; (3) Colloid osmotic pressure of the plasma proteins; (4) Effect of other constituents of blood—e.g., salt, water; (5) Changes in tissue cells.

1. PERMEABILITY OF CAPILLARY ENDOTHELIUM.—Capillary walls are normally: (a) Freely permeable to water; (b) Impermeable to proteins.

PERMEABILITY TO PROTEINS occurs in : (a) Dilatation and injury to capillaries (not easily separable), acute inflammation (inflammatory Œdema), back pressure ; (b) Urticaria ; (c) Histamine poisoning ; (d) Snake-bite.

ŒDEMA WITH HIGH PROTEIN CONTENT OF FLUID occurs in : (a) *Acute nephritis* ; (b) *Cardiac Œdema* (fairly high) ;

ŒDEMA WITH LOW PROTEIN CONTENT.—(a) Cannot be due to increased capillary permeability, as this normally is free in the case of water ; (b) Must be associated with normal capillary walls, as protein does not escape. Includes *nephrosis*, *nephrotic types of glomerulo-nephritis*, *cardiac Œdema* (*partly*). Must depend on other factors.

2. CAPILLARY PRESSURE.—Tends to cause transudation of fluid into tissues. Normally is about 150 mm. H₂O. Rises rapidly with venous stasis—i.e., cardiac failure—but not with raised arterial blood-pressure. *Cardiac weakness thus influences Œdema* ; also dilates capillaries, increasing protein permeability.

3. COLLOID OSMOTIC PRESSURE OF PLASMA PROTEINS.—These proteins consist of fibrinogen (not concerned in Œdema), globulin, and albumin. Globulin and albumin tend to retain fluid in vessels or absorb it from tissues by action of their osmotic pressure. Thus act contrary to capillary pressure.

SERUM (OR PLASMA) GLOBULIN.—Amount : about 2.7 per cent. Total colloid osmotic pressure : about 4 mm. Hg. Large molecule : does not diffuse readily : little excreted in nephritis : regenerated rapidly after loss in hæmorrhage. Thus has slight influence only on Œdema.

SERUM (OR PLASMA) ALBUMIN.—Amount : about 4.3 per cent. Total colloid osmotic pressure : about 30 mm. Hg. Sole function is to prevent loss of fluid from vessels : no nutrient action. Smaller molecule than globulin ; diffuses more readily. Forms 85 to 90 per cent of urinary protein : regenerated slowly. Powerful influence on Œdema.

TOTAL PLASMA PROTEINS.—About 7 per cent.

ŒDEMA AND REDUCTION OF PLASMA PROTEINS.—

Œdema usually occurs if : Total plasma protein falls to 5.5 per cent ; Plasma albumin falls to 2.5 per cent.

Reduction of plasma protein occurs in : (a) Malnutrition—deficient intake ; (b) Hæmorrhage—protein removal ; (c) Massive ascites—protein escapes into fluid ; (d) Chronic nephritis with marked albuminuria.

REDUCTION OF PLASMA ALBUMIN AND CHRONIC RENAL ŒDEMA.—Reduction of plasma albumin is important factor in chronic renal Œdema, e.g., *nephrosis*, and *nephrotic types*. Reduction results from loss by gross albuminuria, which precedes Œdema. Man of 70 kilo has 140 gm. plasma albumin : can lose daily in urine 15 gm. or up to 25 gm. or more : hence rapid variation in plasma protein.

Globulin is less affected, and may (rarely) increase.

Chronic renal Œdema is absent when albuminuria is slight.

Note.—Plasma protein is often further reduced by customary low protein diet and by vomiting.

Factors governing Transudation and Absorption of Fluids, *continued*.

EPSTEIN'S HIGH PROTEIN DIET.—Object is to increase plasma protein: often effective in reducing œdema, especially if level of protein only slightly below critical point.

Note.—Epstein believed that the albumin in nephritis is abnormal and easily excreted by kidneys: probably incorrect.

RELATION BETWEEN œDEMA AND PLASMA ALBUMIN.—Not always parallel. Thus, œdema may disappear suddenly without alteration in plasma protein. Hence must be other factors concerned.

Note.—Osmotic pressure of colloids is 500 to 600 mm. H_2O . Capillary pressure is estimated at about 150 mm. H_2O (not exact). If this is correct, other factors must make up the balance.

4. EFFECT OF OTHER CONSTITUENTS OF BLOOD.—Influence of these much disputed.

RETENTION OF WATER.—Against influence is urged: (a) Blood volume not increased in nephritis; (b) Rapid fluctuations in daily volume of urine; (c) Intravenous saline injections do not cause œdema (normally); (d) Calculous anuria does not cause œdema. Water retention is not accepted as a factor, except possibly in acute nephritis.

RETENTION OF SODIUM CHLORIDE.—Excretion greatly diminished in chronic nephritis with œdema. Administration of sodium chloride increases œdema when present.

Widal's Theory.—Renal defect prevents excretion of chloride, which accumulates in body. Fluid retained in blood to dilute chloride. Hydræmic state results, and water and salt are excreted into tissues.

Objections advanced to Widal's theory: (a) Chloride is retained in pneumonia and nephrosclerosis without œdema; (b) Plasma chloride not invariably increased in chronic renal œdema; (c) Plasma chloride raised in calculous anuria, but no œdema; (d) Blood volume not increased in renal œdema.

Salt-free Diet.—Planned to counteract retention. Admittedly sometimes reduces œdema.

Causes of Retention of Chloride.—(a) In nephrosclerosis—part of general renal inability to excrete; (b) In renal œdema—due to 'pre-renal' deviation of chloride into œdema fluid; (c) In pneumonia—'pre-renal' deviation by deposition in skin and elsewhere.

Note.—Sodium ion is of importance. Thus sodium bromide and bicarbonate also cause retention of water, while potassium salts do not.

5. CHANGES IN TISSUE CELLS.—Now believed that tissue cells have altered affinity for water as result of or associated with altered salt metabolism, especially as to sodium ions, the primary factor being same as cause of renal lesion. The retention of sodium chloride and its action as a factor in production of œdema is thus 'pre-renal'.

Œdema in Acute Nephritis and its Cause.—No reduction exists in plasma proteins. Œdema fluid contains 1 per cent protein. Œdema not extreme, may develop and subside rapidly; may precede albuminuria. Theories as to its cause: (1) Acute nephritis is an acute toxic capillaritis affecting not only glomeruli but general capillaries: resulting moderate increase in permeability to proteins, and hence œdema. (2) Spasm of capillaries raising pressure in them. (3) Altered 'pre-renal' sodium chloride metabolism. (4) Retention of fluids from general insufficiency of secretion (*see above*).

CAUSES OF ŒDEMA IN VARIOUS DISEASES.

<i>Disease</i>	<i>Protein in fluid</i>	<i>Cause</i>
Acute nephritis	Per cent 1·0	Increased capillary permeability to proteins: from toxic capillaritis. Altered sodium metabolism
Chronic diffuse nephritis ..	0·1	Fall in plasma albumin: from albuminuria (cardiac weakness also in contracted types). Altered sodium metabolism
Nephrosis ..		
Ditto, transudates	0·03	
Nephrosclerosis..		When present, due to cardiac failure
Cardiac failure ..	0·5	Increased capillary permeability to proteins: from venous pressure dilating capillaries. Also injury from O ₂ deprivation
Malnutrition ..		Fall in plasma albumin
Cirrhosis of liver with gross ascites		Fall in plasma albumin: drained into ascitic fluid from increased pressure
Inflammatory œdema ..		
Urticaria ..	5 to 7·	Increased capillary permeability to proteins: toxic
Histamine injection		

Note: Vitamins: influence at present obscure.

Variations of Œdema in Course of Nephritis.—May be —

1. ACUTE STAGE.—Œdema present and moderate: due to capillary permeability.
2. SUBACUTE OR CHRONIC STAGE.—Œdema present and gross: due to low plasma protein (œdema may disappear from unknown factors, possibly sodium chloride).
3. CHRONIC STAGE, LATER.—Plasma protein may rise: cause unknown, possibly lessened albuminuria: œdema may disappear.
4. CHRONIC STAGE, ADVANCED.—Œdema may occur from cardiac weakness.

Treatment of Renal Œdema.—(*Note:* Applies to œdema in large and small white kidney (subacute to chronic glomerulo-nephritis) and in nephrosis. For œdema of acute nephritis, see p. 645. Œdema in late stages is treated as in cardiac failure.)

Treatment of Renal Œdema, *continued*.

DIETETICS.—

EPSTEIN'S DIET.—Aims at raising plasma protein (and reducing cholesterol). Only applicable if blood urea low. Is undoubtedly effective in reducing œdema in certain cases: some authorities ascribe this to diuretic action of the urea formed from protein and not to increase of plasma protein.

Basis.—(1) High protein diet; (2) Little fat; (3) Minimum of salt.

Details of Diet.—Protein 120 to 240 gm.; fat 20 to 40 gm.; carbohydrates 150 to 300 gm. Articles: lean ham and veal, whites of eggs, bread, potatoes, butter, lentils, peas, beans, rice, oatmeal, jam, honey, fruit, skimmed milk, coffee, tea, and cocoa. Fluid: 1200 to 1500 c.c.

Note.—Diet as above usually modified: (a) Protein not more than 1.5 gm. per kilo body weight; (b) More fat given.

Œdema may subside rapidly.

SALT-FREE DIET.—Start with milk. Add bread, eggs, rabbit, carrot. No salt allowed. (Diet not longer than three weeks.)

SALT-POOR DIET.—No salt at meals or in cooking. Some restriction advisable in any renal œdema.

FLUID.—Not to be unduly restricted: about 2½ pints daily.

BOWELS.—One or two loose motions daily: avoid purging. Salts preferable. Pulv. jalapæ co. often irritates.

SWEATING.—Encouraged by hot packs or hot-air bath (120° to 140° F.: 15 to 20 minutes): watch pulse.

DIURETICS.—Many in use: most lose effect in few days. *Urea*: 30 to 50 gm. daily. Theocin sodium acetate: gr. 2 to 5 t.d.s. Others: diuretin (gr. 15 to 20 t.d.s.); caffein citrate. Mercurial diuretics are of less efficiency, and dangerous.

DRAINAGE.—From leg, by Southey's tubes or multiple incisions. Strict asepsis important owing to sodden tissues.

DECAPSULATION.—Recovery from œdema and albuminuria is recorded: but relation of cases to nephrosis uncertain. Decapsulation contra-indicated in contracted kidneys.

CHAPTER XCIX.

GENERAL COURSE AND PROGNOSIS OF GLOMERULO-NEPHRITIS.

I. ACUTE GLOMERULO-NEPHRITIS (FOCAL AND DIFFUSE).

Course.—From initial acute attack, following courses may be pursued (see chart, p 637):—

1. Recovery complete.
2. Latent stage. Silent stage.
3. Chronic active stage. Subsequent course nearly always progressively to fatal termination.
4. Continuous rapid progress to fatal end. In diffuse form only.

2. **LATENT STAGE.**—Approximately 50 per cent. Terminations: (a) About 10 per cent finally recover; (b) 5 to 10 per cent, fairly rapid fatal termination (few years); (c) 30 to 35 per cent, long latent course.

CHRONIC ACTIVE STAGE.—Approximately 10 per cent.

CONTINUOUS PROGRESS TO DEATH.—From 10 to 20 per cent.

Duration.—Few days to several months.

Termination.—(a) Acute convulsive uræmia; (b) Œdema, effusions into serous sacs, cardiac failure; (c) Terminal infections, e.g., pneumonia, pericarditis.

SPECIAL FEATURES INFLUENCING PROGNOSIS AT ONSET.—

1. *Œdema, Hæmaturia, and Albuminuria.*—Severity affects prognosis, but recovery may occur with any degree.

2. *Convulsions.*—At onset not specially serious.

3. *Rise of Blood-pressure.*—No prognostic value in first attack.

4. *Plasma Protein.*—If this commences to fall, majority usually pass into chronic active stage.

SUMMARY.—Recovery finally complete: 30 per cent. Latent period lengthy: 30 per cent. Fatal termination within few years: 20 per cent. Rapid fatal termination: 20 per cent.

Acute Hæmorrhagic Nephritis.—

SUBSEQUENT PROGRESS.—

1. **RECOVERY COMPLETE.**—In 75 per cent.

2. **LATENT STAGE.**—In 25 per cent.

Termination.—(a) Complete recovery in 20 per cent; (b) Prolonged latent stage in 5 per cent—very rarely passes to chronic nephritis.

(See also SILENT STAGE, p. 637.)

II. SUBACUTE AND SUBCHRONIC DIFFUSE GLOMERULO-NEPHRITIS.

Onset.—From acute attack progressing through chronic active stage.

Course.—

1. **SUBACUTE TYPE.**—Typical 'large white kidney' (excluding nephrosis). Course progressively downward without remissions. Always fatal.

2. **SUBCHRONIC TYPE.**—Partial intermissions, variations in œdema, and some apparent improvement may occur, but no period of good health. *Very rarely*, passes to latent stage. With removal of definite septic focus, e.g., tonsils, recovery is reported occasionally. Otherwise always fatal.

III. CHRONIC GLOMERULO-NEPHRITIS.

Onset.—May be:—

1. **ACUTE ATTACK.**—Progressing through latent stage to 'secondary small white kidney'.

2. **INSIDIOUS.**—Progresses to either 'primary' or 'secondary small white kidney'. No record of acute attack. Uncertain if (a)

Chronic Glomerulo-nephritis—Onset, *continued*.

no acute attack, or (b) silent stage. Cases of long duration have obscurest onset, attributed to causative factor of less severity though irrecoverable.

General Course.—(See SECONDARY and PRIMARY SMALL WHITE KIDNEY.) Termination, always fatal. The longer the duration the greater the degree of contraction of kidney, i.e., of nephrosclerosis and associated symptoms.

Note.—Intermediate forms occur between all types described, from acute hæmorrhagic nephritis to primary small white kidney.

CHAPTER C.

ACUTE HÆMORRHAGIC NEPHRITIS.

(*Acute Focal Glomerulo-nephritis.*)

A condition characterized clinically by profuse hæmaturia, and pathologically by pure glomerulitis, without usual symptoms or course of nephritis. Onset generally directly connected with inflammation in or around upper air-passages and neck. Common.

SYNONYMS.—Acute focal (non-embolic) glomerulo-nephritis. Essential hæmaturia. (See p. 624.)

Etiology.—Commonest in children and young adults. No age immune. Sexes equal.

Morbid Anatomy.—

MACROSCOPIC.—No obvious change.

HISTOLOGY.—Some glomeruli only affected: in these some capillary loops (not all) of tuft are necrosed. Blood in capsular space. Tubules unchanged or slight necrosis. Some foci of round cells near affected glomeruli. Changes are essentially glomerular, similar to embolic focal nephritis but no emboli.

Pathogenesis.—

1. **RELATION TO SEPSIS.**—Onset in at least 75 per cent (in children) directly related to frank septic (streptococcic) infections in upper air-passages and neighbourhood, especially tonsillitis, otitis media, cervical adenitis. Relationship closer and degree of sepsis greater than in diffuse nephritis. Less definite in adults. Effect ascribed either to (a) emboli of streptococci in loops—no evidence, or (b) toxic effects—probable.

ACUTE INFECTIONS, e.g., scarlet fever, influenza, glandular fever, pneumonia, are also associated.

2. **RELATION TO ACUTE DIFFUSE NEPHRITIS.**—Disputed. Pure hæmorrhagic nephritis is characterized clinically by gross hæmaturia, no oedema or rise of blood-pressure, and by high percentage of rapid complete recovery. Cases also occur with evidence of retention of fluid (rapid gain in weight) or with

slight œdema or slight rise of pressure; these appear much closer to hæmorrhagic (focal) than to diffuse nephritis and suggest intermediate forms. Volhard considers the two types are unconnected, and asserts that slight rise of pressure and any suggestion of œdema indicates diffuse nephritis and prognosis correspondingly more serious. Risk is not immediate, but of slow development of chronic nephritis (small white kidney): with any recognizable œdema possibility of this course must be admitted, and although recovery may appear complete (and remain so for long period) guarded ultimate prognosis must be given, as clinical records are still uncertain. Each such case must be considered separately.

3. **RELATION TO HÆMORRHAGIC DIATHESIS.**—Observations of other hæmorrhages scanty. Purpura of bladder occasionally noted (Kidd). May account for some cases without throat infection.

Hereditary and familial type exists: some intermediate between nephritis and hæmaturia (Hurst).

Symptoms.—

THROAT INFLAMMATION.—Tonsillitis or cervical adenitis especially in children.

ONSET.—Sudden profuse hæmaturia. Usually one to two weeks after throat subsides: no constitutional symptoms except lassitude. Occasionally during throat inflammation, when there is often increased headache and pyrexia and abdominal discomfort.

No pallor. No œdema. No pain. No retinal or cardiovascular changes. No biochemical changes. May be epistaxis.

URINE.—Bright red blood. No gross sediment. In early stages, there may be cellular and granular casts, scanty and transient. Occasionally oliguria.

BLOOD.—Leucocytes often 10,000 to 12,000; mainly polymorphs, but occasionally lymphocytosis.

Course and Prognosis.—(See also *PATHOGENESIS above*, and, *GENERAL COURSE AND PROGNOSIS OF GLOMERULO-NEPHRITIS*, p. 636.) Divisible into three groups:—

1. **RECOVERY COMPLETE.**—Blood disappears rapidly; macroscopically in 3 to 4 days; occasionally lasts 3 to 4 weeks (tonsillectomy may be advisable). About 75 per cent. Albuminuria rarely persists for some weeks.

2. **LATENT STAGE** (*see* p. 638).—About 20 per cent. Whence ultimately complete recovery (may be recurrences of hæmaturia).

3. **LONG LATENT STAGE.**—Gradually forms small group with ill health, persistence of definite albumin and blood, and possibly low urea concentration, and slight increase of blood urea and blood-pressure. These may drift into nephritis in course of years.

SILENT STAGE.—*See* *COURSE OF ACUTE GLOMERULO-NEPHRITIS*, p. 637.

Diagnosis.—In adults without sepsis, from surgical hæmaturia.

Treatment.—Simple. Preferably rest in bed until no albumin or red cells in urine. Septic tonsils and foci must be removed.

Embolio Focal Glomerulo-nephritis.

In subacute bacterial endocarditis. Due to emboli of cocci blocking capillary loops. Histology otherwise as in non-embolic type. Hæmaturia often microscopic only. No other renal manifestations.

CHAPTER CI.

ACUTE DIFFUSE NEPHRITIS.

Acute inflammation of the kidneys, characterized pathologically by changes principally in the glomeruli and to a less extent in the tubules, and clinically by albuminuria, hæmaturia, œdema, and rise of blood-pressure. Not common.

SYNONYMS.—Acute diffuse glomerulo-tubular nephritis or glomerulo-nephritis. Acute parenchymatous nephritis. (*See* p. 625.)

Etiology.—

1. INFECTIONS.—*Hæmolytic streptococcal infections* present in 60 to 80 per cent of all cases. Infections of tonsils, neighbouring glands, upper air-passages, and sinuses predominate, especially acute tonsillitis, scarlet fever, otitis media. Also boils and skin infections. *Influenza*. Pneumonia and other specific fevers less common. Dental sepsis: relation uncertain and not obvious. Syphilis causes acute nephrosis. Alcohol: not causative as single factor.

NOTE 1.—Nephritis is directly due to action of organisms or toxins. The original infection, e.g., tonsillitis, is frequently not of great severity and may have attracted little attention.

NOTE 2.—Urine and blood are sterile even in acute nephritis directly following infections: exceptions very rare. Association of nephritis and rheumatic fever is very rare.

2. COLD.—Chill is an important exciting factor.
3. PREGNANCY.—Eclamptic and toxæmic kidneys have special characteristics, not here referred to.

Less common:—

4. TOXIC AGENTS.—Drugs such as turpentine, potassium chlorate, cantharides, carbolic acid. Experimentally: certain bacterial toxins; also vinylamine.
5. SKIN LESIONS.—Besides boils and carbuncles, chronic skin conditions, erythemata, etc., are occasionally associated with nephritis.
6. EPIDEMIC NEPHRITIS.—*See* p. 646.

Morbid Anatomy.—

MACROSCOPIC.—Kidneys large, deep red, capsule strips easily, leaving marbled surface and prominent stellate vessels.

ON SECTION.—Marked congestion. Cortex swollen. Glomeruli often prominent. Differentiation of cortex and medulla distinct. Pyramids deep red. Changes may be slight.

HISTOLOGY.—

1. **GLOMERULI.**—All glomeruli and all loops affected: loops swollen and cells increased. Blood in some capsular spaces. Later, capsule swells, cells proliferate; forms crescent bodies and adhesions to glomeruli.
2. **TUBULES.**—Early: little affected, some cloudy swelling; contain blood and casts. Later: degeneration and desquamation of epithelium; in places, masses of various cells and casts.
3. **INTERSTITIAL TISSUES.**—Inflammatory exudate: blood cells or small round cells. Vessels dilated.

Symptoms.—

MODE OF ONSET.—Variable. In children, and following chill, often rapid; in specific fevers insidious. Typical symptoms commoner in children; in adults often slight malaise with severe urinary changes.

SYMPTOMS AT ONSET.—(1) Headache; (2) Puffiness of eyes and face, and of ankles; (3) Nausea and vomiting; (4) Urine diminished and altered. General malaise. Constipation. Temperature 101° – 103° ; in adults may be apyrexial. Complexion pasty; skin dry; tongue furred; pulse not specially rapid. May be rigors or, in children, convulsions. Dyspnoea occasionally in adults. Pain in back and loins.

CONDITION DEVELOPED.—

FACIES.—Pallor (but blood may show little change). Soft tissues swollen, but may not pit.

ŒDEMA.—Chiefly affects subcutaneous and loose areolar tissues, especially eyelids and ankles; sacrum and scrotum common. May be universal. Pleural and peritoneal exudations and œdema of lungs occur, but not so frequently as in cardiac dropsy.

BLOOD-PRESSURE.—Raised; varies with severity. In adult, may be 160 systolic, or rarely 180 mm.: Less in children. Attributed to cerebral œdema or to toxic action on nervous system. Increase especially with convulsions.

FUNDI.—No retinal changes except dilated veins and rarely a few hæmorrhages. (In pregnancy may be retinitis.)

URINE.—

Sterile.

Quantity.—Scanty. Often a few ounces daily.

Colour.—Deep or smoky (blood).

Specific Gravity.—1025 to 1035.

Albumin.—Large quantity.

Urea.—Percentage may be high.

Deposit.—Blood-cells, red and white; hyaline, granular, epithelial, and blood casts; much débris.

Chlorides.—Trace only.

BLOOD UREA.—Increased; varies with severity. Cholesterol normal.

UREA EXCRETION.—Daily total diminished.

Acute Diffuse Nephritis, continued.

Progress.—Outlook always serious.

IN FAVOURABLE CASES.—(Recovery or to latent stage.) Improvement may commence after few days or in one to two weeks. Duration to recovery or to latent stage often 4 to 6 months or more. Increase in amount of urine, excretion of urea and chlorides, diminution of œdema, and fall in blood urea (and often of blood-pressure) usually run parallel; polyuria often marked.

IN UNFAVOURABLE CASES.—Symptoms increase: œdema, vomiting, and often convulsions. May be continuous progressive increase in symptoms, and death in a few weeks (or days), or in 3 to 4 months; or may be partial intermissions.

Apparent general improvement and diminution of œdema may occur in course of several months although renal affection is advancing: blood urea must be watched.

BLOOD-PRESSURE.—Increase at onset is no guide in prognosis.

ŒDEMA AND ALBUMINURIA.—Severity affects prognosis, but recovery may occur with any degree.

CONVULSIONS.—Recovery frequently occurs. At onset in children are not specially serious.

SEROUS EFFUSIONS.—Serious complication.

'SILENT STAGE'.—See GENERAL COURSE OF ACUTE GLOMERULO-NEPHRITIS, p. 637.

Termination.—(Figures given are provisional.) (See also GENERAL COURSE AND PROGNOSIS OF GLOMERULO-NEPHRITIS, p. 636.)

1. **DEATH.**—From uræmia, extension of œdema, cardiac failure, secondary infections, and complications. Occurs as: (a) Direct progress from onset: about 10 to 20 per cent. (b) Progressing through chronic active stage and large white kidney: about 10 per cent (in adults).
2. **RECOVERY, COMPLETE.**—Either: (a) Direct from acute attack: about 20 per cent. (b) Through *latent stage* of varying duration: about 10 per cent.
3. **LATENT STAGE.**—Apparent recovery in 50 per cent, progressing to: (a) Final recovery: 10 per cent. (b) Chronic nephritis—small white kidney: 40 per cent.

COMPLICATIONS.—Pericarditis, pneumonia, pleurisy.

Note.—Apparent recovery (complete recovery and latent stage) occurs in about 70 per cent: of these, final recovery in 30 per cent, and nephritis subsequently in 40 per cent. (Acute hæmorrhagic nephritis is not included.)

Diagnosis.—Usually simple. Difficulties arising are mainly due to not examining urine: symptoms may thus suggest anæmia, acute gastritis (vomiting), various cerebral conditions (headache and vomiting). Symptoms may be very slight in adults—a puffiness of the eyes noticed by friends—even with marked albuminuria.

OTHER FORMS OF ALBUMINURIA causing difficulty:—

1. Febrile albuminuria is not necessarily acute nephritis.
2. Passive congestion of kidneys or renal infarct in heart disease.
3. Acute exacerbation in chronic nephritis. Cardiovascular and ocular changes present.
4. Acute hæmorrhagic nephritis.

Treatment.—*Indications*: (1) Rest kidneys by: (a) Dieting; (b) Utilization of skin and bowels for excretion. (2) Treat symptoms. (3) Remove any septic focus (not in acute stage). *Heart* must be carefully watched: stimulants and glucose if weak.

GENERAL HYGIENE.—Keep patient in bed until condition has disappeared, at onset between blankets and clad in flannel.

DIET.—

AT ONSET.—*Preliminary 'starvation' period*, few days up to 7 or 10 days, depending on progress: fluid, fruit-juice, and sugar only. Then milk, sugar, bread and butter in increasing amounts.

PROGRESS.—Add carbohydrates and starches. Thicken milk with arrowroot; then gruel and arrowroot, and fruit. Avoid meat extracts. No alcohol. *Increase of diet* to be gradual, especially with meat, changes being guided by the urine as well as by symptoms. If with lapse of time more food is necessary though œdema persists, give salt-free diet (*see* CAUSES OF ŒDEMA, p. 634).

ORDER OF ADDITIONS TO DIET.—Farinaceous food; bread and butter. Eggs. Fish and vegetables. Chicken. Meat.

FLUID.—For 3 to 5 days fluid scanty, then give fluid freely but not in excess: for adult 3 pints, for child $1\frac{1}{2}$ pints. Alkaline drinks, such as lemonade and potus imperialis (acid potassium tartrate \mathfrak{z} ij, lemon-juice \mathfrak{z} ss, syrup \mathfrak{z} ss, water to a pint). If necessitated by vomiting, give fluid by bowel. If œdema severe, avoid unnecessary amount but do not stint fluid.

EXCRETION BY SKIN.—Sweating encouraged by hydrotherapy daily hot pack, or hot-air bath (first bath not exceeding 120° to 140° F., never exceeding 170°); duration 15 to 20 minutes; watch pulse and stop on weakening: sweating is assisted by hot drinks. Pilocarpine increases sweating but risk of bronchorrhœa.

Promotion of sweating often difficult, especially in dry skin of uræmia.

EXCRETION BY BOWELS.—Must be open regularly but not freely purged. Give morning saline: sulphate of magnesium (\mathfrak{z} j or more in little fluid); for children, fluid magnesia. Pulvis jalapæ co. (\mathfrak{z} ss for adult man) or pulvis elaterinæ co. also good, but may cause diarrhœa.

DIURETICS.—No drug directly controls kidney changes or influences albuminuria. As diuretics, digitalis or strophanthus may be used *when acute symptoms have cleared* and blood-pressure not high, e.g., Guy's pill. Strong diuretics are contra-indicated.

SPECIAL SYMPTOMS.—

HIGH BLOOD-PRESSURE.—*Venesection*.

VOMITING.—Often troublesome. Ice to suck. Tinct. iodi (\mathfrak{M} j in water \mathfrak{z} ss, hourly), or dilute hydrocyanic acid (\mathfrak{M} ij, t.d.s.).

Restrict food. Fluid by rectum.

ŒDEMA.—Pleural exudate and ascites (rarely) may need removal, if causing symptoms from pressure. (*See* p. 635.)

CONVULSIONS AND URÆMIA.—*See* p. 630.

ANURIA.—Decapsulation occasionally successful.

ANÆMIA.—After acute symptoms have subsided, *give iron*.

Acute Diffuse Nephritis—Treatment, *continued*.

ALKALI TREATMENT.—Commence with pot. cit., pot. bicarb., sod. cit., sod. bicarb., aa gr. 15, t.d.s. : increasing to 600 to 900 gr. daily. Alkali reserve to be watched as alkalosis may develop. Good results claimed ; not yet confirmed.

CONVALESCENCE.—Avoid chills. Give tonics. Keep bowels open. Moderate diet.

OTHER FORMS OF ACUTE NEPHRITIS.

1. Acute Epidemic Nephritis.—A few definite epidemics are recorded. Onset is nearly always preceded by tonsillitis. Symptoms typical, with œdema. Complete recovery almost invariable, with no sequelæ.

2. War Nephritis.—Acute nephritis began to affect large numbers among the troops in France in March, 1915, and remained prevalent until the end of the War. It was almost, but not entirely, confined to troops in the front line.

The general condition resembled civilian nephritis except for the constancy of marked dyspnœa, and the frequency of respiratory symptoms.

Progress was usually rapid and favourable. Œdema and albuminuria generally diminished rapidly, accompanied by well-marked diuresis, fall in blood-pressure and body weight, and rise in percentage of hæmoglobin in the blood. Disease tended to be considerably milder than civilian nephritis. Immediate mortality about 4 per cent.

After-history of cases still being studied. Indication of higher incidence of chronic nephritis.

3. Acute Interstitial Nephritis.—A true inflammatory reaction of the kidney due to acute infection with organisms, usually streptococci. No relation to chronic interstitial nephritis. Often associated with streptococcal tonsillitis or pharyngitis : occasionally with septicæmia. Usually initially unilateral, right side, but left may follow. Commoner in females.

MORBID ANATOMY.—Kidney enlarged, soft and engorged. Microscopically : numerous foci of lymphocytes ('round cells'). Glomeruli and tubules intact but may be invaded by inflammatory foci.

SYMPTOMS.—*Onset* : sudden. Pyrexia ; rigors, rapid pulse. Pain and rigidity in loin. Kidney often palpable. No œdema.

URINE.—Variable, much or no blood. May be anuria. Usually sterile ; rarely cocci identical with throat cultures.

DIAGNOSIS.—From appendicitis and perinephric abscess.

TREATMENT.—Fomentations locally. If anuria, decapsulation or nephrotomy.

PROGNOSIS.—Good, unless sepsis elsewhere. No subsequent nephritis.

CHAPTER CII.

SUBACUTE AND SUBCHRONIC GLOMERULO-NEPHRITIS.*(Large White Kidney, excluding Nephrosis.)*

SYNONYMS.—Chronic parenchymatous nephritis. Hydræmic nephritis. (See p. 625.)

Types.—Two in number:—

1. **SUBACUTE:** 'EXTRACAPILLARY' TYPE.—Duration: 3 months to 1 year. (Typical 'large white kidney'.)
2. **SUBCHRONIC:** 'INTRACAPILLARY' TYPE.—Duration: 6 months to 3 years or more. Some contraction occurs (depending on duration) with associated characters. The most chronic types merge into 'secondary small white kidney'.

I. SUBACUTE TYPE: 'EXTRACAPILLARY'.

Etiology.—

1. Sequel of acute nephritis.
2. Insidious onset.

AGE.—Especially children and young adults.

Morbid Anatomy of Kidney.—

MACROSCOPIC.—Large kidney (6 to 9 oz. each). Capsule thin, strips readily. Surface smooth and pale. Stellate veins injected.

ON SECTION.—Cortex swollen and opaque yellowish-white. Demarcation distinct. Pyramids usually congested.

HISTOLOGY.—

GLOMERULI.—Moderately enlarged. Many bloodless. Endothelial proliferation and leucocytic infiltration. Hyaline degeneration of some loops.

CAPSULE.—Thickened. Adhesions to tuft frequent. Epithelial proliferation common. 'Crescent' bodies composed of cells and fibrin in some capsular spaces: may block efferent tubule. (Fahr's *extracapillary* type.)

TUBULES.—Changes prominent. Epithelium desquamated; hyaline and granular degeneration. Tubules in places distended with masses of such cells; in other places empty and collapsed.

INTERSTITIAL TISSUE AND ARTERIES.—Oedematous. Infiltration with leucocytes and round cells.

Symptoms.—

MODE OF ONSET.—Acute diffuse nephritis of varying severity. Initial symptoms partly improve: hæmaturia may cease: oedema persists.

CHIEF SYMPTOMS AND SIGNS.—

1. **OEDEMA.**—Early, marked, and obstinate. Earliest in face (in morning) and feet. May be general, involving serous membranes. Ascites very common.

Subacute Glomerulo-nephritis—Symptoms, *continued*.

2. GASTRO-INTESTINAL SYMPTOMS.—Nausea ; anorexia ; vomiting (may be serious) ; more rarely diarrhoea.
3. PALLOR, WEAKNESS, and WASTING.—Last may be masked by œdema. May be true anæmia, but hæmoglobin often unexpectedly high.
4. HEADACHE.
5. TONGUE : furred. BREATH : foul. PYREXIA : rarely exceeds 101° in absence of complications.

URINE.—

SPECIFIC GRAVITY.—1020 to 1035.

COLOUR.—Turbid with urates, or smoky with blood.

QUANTITY.—Reduced (20 to 25 oz.). Varies with extent of œdema. Varies also with vomiting, purging, and treatment.

ALBUMIN.—Abundant. Frequently 1 per cent.

DEPOSIT.—Casts of various sizes and kinds—hyaline, granular, epithelial, and fatty ; leucocytes, often numerous ; may be red cells.

Various Characteristics.—

BLOOD-PRESSURE.—May be raised. May vary rapidly.

HÆMATURIA.—Present or absent.

CHLORIDES.—Urine : greatly diminished. Blood : variable.

BLOOD PROTEIN.—Low. Cholesterol : normal.

BLOOD UREA.—Often normal. May rise.

RENAL EFFICIENCY TESTS.—Often are normal. May be deficiency.

RETINAL CHANGES.—Neuro-retinitis.

'Nephrotic Type of Glomerulo-nephritis'.—In the absence of hæmaturia, raised blood-pressure, etc., the condition temporarily simulates nephrosis.

Diagnosis.—From :—

CARDIAC ŒDEMA.—Œdema general. Casts. No general signs of failing heart. Cholesterol normal. May be difficult.

NEPHROSIS.—Differentiated by hæmaturia, blood-pressure, etc. In absence of these—viz., in 'nephrotic type of glomerulo-nephritis'—diagnosis by history of acute nephritis or hæmaturia, and by normal cholesterol.

SMALL WHITE KIDNEY (nephrotic stage).—By short duration.

Prognosis.—With established diagnosis, prognosis is hopeless : duration three months to one year. *No intervals of good health.* Apparent recoveries are in reality : (1) Nephrosis ; (2) Nephrotic type of small white kidney, with temporary improvement.

Mode of Death and Complications.—

1. Acute convulsive uræmia.
2. General anasarca and cardiac failure.
3. Pneumonia, pleurisy, and pericarditis.

Treatment.—As for acute nephritis and œdema (*see* p. 635). Otherwise symptomatic. Septic foci to be treated.

II. SUBCHRONIC TYPE: 'INTRACAPILLARY'.

Principal differences only from subacute type are noted here.

Morbid Anatomy of Kidney.—As in subacute type with following differences:—

MACROSCOPIC.—Kidney about normal size or enlarged

ON SECTION.—Demarcation indistinct. Opaque lipoid may be visible in cortex

HISTOLOGY.—

GLOMERULI.—Greatly enlarged, with many cells: many loops hyaline. Some glomeruli collapsed. (Fahr's *intracapillary* type.)

CAPSULE.—Changes slighter: proliferation not marked. No crescents.

TUBULES.—Less distended, but lipoid degeneration frequent.

INTERSTITIAL TISSUE.—Diffuse irregular fibrous tissue infiltration.

VESSELS.—Arteriosclerosis of recognizable degree. May be some cardiac hypertrophy.

Symptomatology.—

MODE OF ONSET.—Acute diffuse nephritis: often of mild severity.

ŒDEMA.—Severe characteristically, but may vary rapidly and disappear. In later stages blood protein may rise to normal and œdema is cardiac and not renal.

URINE.—Amount variable, related to variations in œdema. (Albumin abundant).

BLOOD-PRESSURE.—Raised and continues to rise.

RENAL DEFICIENCY.—Definite, shown by various tests (blood urea, etc.).

RETINAL CHANGES.—Neuro-retinitis, macular star.

Course and Prognosis.—Partial intermissions, variations in œdema, and some apparent improvement may occur, but no period of good health. Always fatal. Very rarely, passes into latent stage. Terminations as in subacute type but uræmia commoner. Duration: six months to two years, or rarely three years.

CHAPTER CIII.**CHRONIC GLOMERULO-NEPHRITIS:
SECONDARY SMALL WHITE KIDNEY.**

SYNONYMS.—See p. 625.

This type is of great importance owing to onset being frequently insidious and obscure (long latent stage or silent stage), slowness of manifestations over a period of years, variable progressive and intermittent course, and final fatal termination. Includes many clinical cases of 'chronic nephritis'. Not uncommon.

Chronic Glomerulo-nephritis, continued.

Possibly commences from a toxæmia involving kidney but with renal changes completely clinically 'silent' though progressive: in time reaches degree of a 'latent stage': and subsequently degree of nephritic manifestations. Rarely traceable to definite attack of acute nephritis.

Relation to Acute Focal Glomerulitis (acute hæmorrhagic nephritis).—It has been suggested that small white kidney (both secondary and primary) is end-result of initial attack of acute focal glomerulitis with long 'silent', 'latent', and subsequent stages. Basis of theory: (a) Fibrosis is coarsely reticular, i.e., focal, as opposed to a diffuse distribution; (b) Some glomeruli show no inflammation and are hypertrophied. Clinical after-history in focal glomerulitis proves total recovery in high percentage, and does not support this, but it is still undecided.

Morbid Anatomy of Kidney.—(Note.—Degree of contraction and of vascular changes varies with duration. Following description applies to a prolonged course.)

MACROSCOPIC.—Kidney small ($1\frac{1}{2}$ to 3 oz. each in extreme cases), and granular. Pale or mottled. Capsule thick and adherent.

ON SECTION.—Tough. Cortex reduced, pale and opaque. Demarcation indistinct. Fat in hilus appears increased.

NOTE ON COLOUR.—Is not invariably 'white'—e.g., with cardiac failure may be congested.

HISTOLOGY.—

GLOMERULI.—Many small, atrophied, and hyalinized completely or partly. Surviving glomeruli hypertrophied.

CAPSULES.—May be proliferated. Remains of crescent bodies hyalinized or organized. Adhesions to glomerulus.

TUBULES.—Many entirely destroyed and replaced by fibrous tissue. Others (glomeruli still acting) dilated; often in groups or 'islands' (appearing as 'granules' macroscopically). Cells absent, or hyaline or with lipoid. Lumen contains casts, cells, blood.

ARTERIES.—Intima of small arteries thickened and fatty. Elastic layer proliferated. Media hypertrophied. Afferent arteries to obliterated glomeruli hyaline.

INTERSTITIAL TISSUE.—Greatly increased. Irregular network surrounding islands of hypertrophied tubules. Lipoid in foam cells.

GENERAL PROGRESS.—(1) Continued destruction of glomeruli; (2) Progressive arterial change.

Age at Onset.—May be first recognized at any age from childhood to adult life.

Symptomatology.—Three stages can be described:—

1. **STAGE OF LATENCY AND RECURRENCE.**—From initial recognition or acute attack, clinical recovery either apparently complete or nearly complete or in 'latent stage'. Pallor and fatigability may remain or gradually develop. Blood-pressure and renal tests normal. Albuminuria persists or temporarily

absent. In absence of definite attack causing recognition, fatigue gradually attracts attention and albumin may be found on routine examination. This stage is characterized by attacks, with apparently normal health in intervals.

RECURRENCES OF NEPHRITIS.—Mild or severe. Duration : days or weeks.

CEDEMA.—Variable : (a) Absent for years, or (b) present for periods, and may be severe. Later resembling nephrosis, i.e., 'nephrotic type' (blood protein low).

URINE.—Albuminuria and casts. Changes slight except in attacks.

RETINAL CHANGES.—Absent.

PROGRESS.—*Gradual*. Evidences of advance at first absent. Development of slight renal insufficiency and increased blood-pressure during attacks, but yielding to treatment. Later also in intervals.

DURATION.—May be 10 years or more.

2. STAGE OF RELATIVE RENAL INSUFFICIENCY.—Pallor, puffiness, headache, and fatigue becoming noticeable. In this stage, health is not completely regained in intervals between recurrences.

RECURRENCES AND EXACERBATIONS more noticeable.

CEDEMA.—Either (a) absent, or (b) severe, 'nephrotic type', with some hypercholesterolaemia; blood protein low. May be convulsions.

BLOOD-PRESSURE.—Persistently raised and slowly rising; little affected by treatment.

BLOOD UREA.—Rising; may temporarily return to normal.

UREA ELIMINATION TESTS.—May reach normal, but deficiency commencing.

RETINAL CHANGES.—Neuro-retinitis and macular star (lipoid exudate) developing.

DURATION.—Two to 5 or up to 10 years.

DEATH.—May occur from : (1) Acute convulsive uraemia; (2) Cardiac failure.

3. STAGE OF ABSOLUTE RENAL INSUFFICIENCY.—Symptoms progress rapidly: puffiness, headache, dim vision, passing to symptoms of uraemia, e.g., vomiting and wasting. In this stage, failure is continuously progressive.

BLOOD-PRESSURE.—Rising rapidly, may exceed 280 mm. systolic and 180 diastolic; may fall before death. Cardiac hypertrophy.

BLOOD UREA.—Rises to enormous figures.

UREA ELIMINATION TESTS.—Increasing deficiency.

URINE.—Quantity usually increased, especially nocturnal. Polyuria: lower with oedema. Albumin and casts present: variable amount. May be haematuria.

CEDEMA.—May be : (a) Absent (blood protein rising terminally); (b) Cardiac; (c) Nephrotic (unusual).

ANÆMIA.—Often severe; colour index may be high, or low if hæmorrhages.

Chronic Glomerulo-nephritis—Symptomatology, continued.

RETINAL CHANGES.—Neuro-retinitis and macular star.

DURATION.—Few months.

DEATH.—From : (1) True chronic uræmia ; (2) Cerebral and other hæmorrhages ; (3) Cardiac failure.

Prognosis.—Invariably fatal. Expectation of life difficult to assess in early stages. Fatal within 2 years of retinal changes. Last stage rapid.

Diagnosis.—From other groups of nephritis, may depend on previous history.

1. **IN STAGES OF LATENCY AND RELATIVE INSUFFICIENCY.**—From large white kidney and nephrosis.
2. **IN STAGE OF ABSOLUTE INSUFFICIENCY.**—From nephrosclerosis, viz., arteriosclerosis and red granular kidneys. Usually by younger age, previous history, and anæmia. End stages may be inseparable clinically.

Treatment.—As for oedema, acute nephritis, and nephrosclerosis, depending on symptoms. Otherwise symptomatic. General routine and diet should not be too strict in intervals.

CHAPTER CIV.

CHRONIC GLOMERULO-NEPHRITIS : PRIMARY SMALL WHITE KIDNEY.

(*Chronic Glomerulo-tubular Nephritis.*)

A group in which symptoms and pathological changes of the terminal stage of secondary small white kidney suddenly appear without previous ill-health or nephritic history. Uncertain if : (a) Primary degeneration of kidney, i.e., *renal dysbiotrophy* (familial cases are known) ; or (b) Sequel of an unrecognized previous progressive nephritis, through a 'silent stage'. Both groups may exist. Usually young adults, 18 to 30 years of age, but may be in infancy. (For pathogenesis, see SECONDARY SMALL WHITE KIDNEY.)

SYNONYMS.—See p. 625.

Morbid Anatomy, Symptoms, and Renal Efficiency.—As in last stages and most advanced grades of secondary small white kidney. Congenital deformities not uncommon.

Onset.—Headache, nausea, vomiting ; wasting, weakness, and often anæmia. All may be of great severity. Failure of vision and advanced retinal changes. Uræmia may occur as initial symptom.

Cardiovascular Changes.—Usually marked from onset of symptoms : cardiac hypertrophy, small hard arteries, blood-pressure raised and may exceed 300 mm. Hg. Occasionally less severe.

Note.—A group exists in which blood-pressure is normal.

Progress.—Rapid. Duration: few months to few weeks, or even few days. Death in uræmia or hæmorrhage, cerebral or elsewhere.

Note 1.—Headache, vomiting, and retinitis may closely simulate cerebral tumour.

Note 2.—In renal infantilism, similar conditions may occur rarely.

CHAPTER CV.

NEPHROSIS.

(*Lipoid Nephrosis. Degenerative Tubular Nephritis.*
Hydræmic or Hydropigenous Nephritis.)

A condition characterized pathologically by changes confined to non-inflammatory degenerative lesions of the renal tubules, and clinically by œdema, albuminuria, fall in plasma proteins, and hypercholesterolæmia, with absence of hæmaturia, of cardiovascular changes, and of decreased renal function, and by tendency to recovery.

SYNONYMS.—See p. 625.

Types of Nephrosis.—

1. TRUE CHRONIC OR LIPOID NEPHROSIS (Volhard).—

(a) Cryptic; (b) Toxic (syphilis).

LIPID.—(Cholesterol.) *Doubly refractile*, exhibiting bright Maltese cross under polarizing microscope. Only occurs in nephrosis, nephrotic forms of glomerulo-nephritis, amyloid disease, and rarely in arteriosclerotic Bright's disease. Deposition of lipid is an incident connected with hypercholesterolæmia, and is not a distinguishing characteristic of nephrosis.

2. PREGNANCY NEPHROSIS.

3. AMYLOID DISEASE.—From syphilis, tuberculosis, chronic suppuration. (See p. 664.)

4. ACUTE NEPHROSIS.—May occur in diphtheria, typhoid, etc.; little clinical importance.

5. NECROTIZING NEPHROSIS.—From bichloride of mercury. Tubules only affected, but differs clinically in: anuria, blood urea raised, œdema usually absent.

Note.—This chapter refers solely to true chronic non-syphilitic nephrosis.

Morbid Anatomy.—

KIDNEYS.—

MACROSCOPIC.—Kidneys large and pale. Capsule strips readily. Smooth surface. Stellate veins marked.

On Section.—Surface appears wet. Cortex wide and yellow, contrasts with brown-red pyramids. Yellow streaks and spots (lipoid) in cortex.

Nephrosis—Morbid Anatomy, continued.**HISTOLOGY.—**

Tubules.—Especially proximal convoluted tubules and descending loop of Henle. *Cells swollen, with lipid and hyaline degeneration*; may be areas of regeneration, viz., flat epithelioid cells with dark nuclei. Lumen dilated with desquamated cells and granular protein precipitate. Changes patchy and other tubules little affected.

Glomeruli.—Normal. May be slight cellular swelling.

Interstitial Tissue.—Deposits of lipid in foam cells. Some round-cell infiltration.

Vessels.—Normal.

ATHEROMATOSIS of descending aorta and mitral valve.

Other organs normal.

Recognition of Nephrosis.—

MULLER.—Applied term to kidney with sole change of degeneration of tubules.

MUNK; VOLHARD.—Connected such pathology with œdema, absence of hæmaturia, and deposits of lipid.

EPSTEIN.—Found plasma proteins diminished.

Theories of Pathogenesis.—Principal views:—

1. **A PRIMARY METABOLIC DISTURBANCE.**—An unknown cause, extra-renal and non-renal, alters lipoids and plasma proteins, which become excretable. Tubules injured by their excretion or by same unknown cause. But there is no evidence of alteration of proteins, etc.
2. **INCREASED GLOMERULAR PERMEABILITY.**—Permits albumin and lipid to pass, which is reabsorbed by and thus injures tubules, but not irrecoverably.
3. **A PRIMARY TUBULAR DEGENERATION.**—This allows passage of albumin.
4. **MILD GLOMERULO-NEPHRITIS.**—Changes in glomeruli subsiding and in tubules persisting. A 'burnt-out' glomerulo-tubular nephritis. (Aschoff.) Not generally accepted.
5. **HYPOTHYROIDISM.**—Based on low basal metabolic rate and tolerance to thyroxin. (Epstein.)

ŒDEMA.—Attributed to diminished osmotic pressure of plasma proteins owing to loss by albuminuria—probable cause; may be other obscure pre-renal factors. Is not directly due to tubular lesions. Œdema fluid contains very little protein. (*See CAUSES OF ŒDEMA*, p. 632.)

NOTE.—Lipoid disturbance and hypercholesterolaemia in other diseases—e.g., diabetes, Niemann-Pick's disease, and lipid histiocytosis—affect other organs.

Syndrome is worthy of distinction provisionally from other forms of nephritis owing to frequent recovery.

Etiology.—

AGE.—Usually children and young adults. Rare over 30.

SEX.—Equal in male and female.

PREDISPOSING CAUSES.—Usually none. Indefinite relation to chill and catarrh of upper air-passages, but no tendency to tonsillitis.

Symptoms.—

MODE OF ONSET.—Insidious frequently; œdema first attracts attention. Occasionally rapid. Sometimes malaise and nausea precede œdema.

POSITIVE CHARACTERISTICS.—*Gross œdema*; and serous effusions. Albuminuria. Oliguria. Urinary sediment containing lipoid (polarizing microscope). Renal efficiency tests and blood urea normal. Decreased protein and increased cholesterol content of blood. Decreased basal metabolic rate. Increased tolerance to thyroxin.

NEGATIVE (ABSENT) CHARACTERISTICS.—Hæmaturia. High blood-pressure. Cardiac hypertrophy. Retinal changes. True uræmia.

CONSIDERATION OF SYMPTOMS.—

ŒDEMA.—Often extreme. Either generalized or asymmetrical. May persist unchanged for months and then rapidly disappear, irrespective of treatment.

SEROUS EFFUSIONS.—Ascites and hydrothorax common. Often 'pseudo-chylous' from cholesterol (1.5 to 5 mgrm. per cent).

PALLOR.—No true anæmia.

URÆMIA.—There may be convulsions, i.e., acute convulsive uræmia (usually recovery), but not true chronic uræmia.

URINE.—

ALBUMINURIA.—Large amounts: may be 1 to 5 or 6 per cent. Little globulin.

OLIGURIA.—Under 30 oz. Specific gravity 1020 to 1040.

HÆMATURIA.—Characteristic absence on repeated examination.

DEPOSIT.—Casts characteristically absent, may be few hyaline. Leucocytes scanty. Red cells completely absent, or very few. *Doubly refractile lipoid particles* present, as droplets or casts.

UREA CLEARANCE TEST.—Normal.

WATER ELIMINATION TEST.—Reduced excretion of water.

BLOOD.—*Volume*: normal. *Chlorides*: vary with œdema and diuresis: high, normal, or somewhat decreased. *Calcium*: falls to 7-9 mgm.: never tetany. *Acid-base balance*: normal. *Sedimentation rate*: increased.

BLOOD UREA.—Normal.

PROTEIN.—Reduced greatly. Albumin, 2 per cent or less (normal 4). Globulin normal or slightly increased, 2.5 to 3 per cent. Albumin to globulin ratio reduced: 1 to 2 (normally 2 to 1).

CHOLESTEROL.—Enormous increase. Lipæmia: from 300 to 800 mgm. per cent, or more (normal 150 to 220 mgm.). Explanation unknown: may be abnormal metabolism from tissues broken down in malnutrition.

BASAL METABOLIC RATE.—Metabolism diminished. *Thyroid* tolerated in large doses, as in all œdema.

Nephrosis, continued.

Course.—Chronic, with or without remissions; œdema may persist unaltered by treatment. Recovery usually after weeks or months.

Fatal Terminations.—(1) Complications, often simulating pneumococcal peritonitis. (2) Glomerular nephritis develops and renal failure (rare). (3) Convulsive uræmia. (4) Cardiac failure.

Diagnosis.—Clinical syndrome of nephrosis is also produced in nephrotic stages of large and small white kidney. In these, note: (1) Hæmaturia present at onset or during course; (2) Length of history; (3) Hypertension. Differentiation may be impossible: many cases simulating nephrosis finally prove to be nephritis.

In amyloid disease and other forms of nephrosis: causal condition present.

Treatment.—As for œdema (*see* p. 635). Special measures: high protein and salt-poor diet; fat-poor if cholesterol high; thyroid; decapsulation of kidney.

CHAPTER CVI.

NEPHROSCLEROSIS.

(*Renal Arteriosclerosis. Arteriosclerotic Bright's Disease. Chronic Interstitial Nephritis.*)

A clinical and pathological group characterized by vascular changes in the kidneys with concomitant parenchymatous changes, and by high blood-pressure. Cardiovascular symptoms marked. Uræmia and cerebral hæmorrhage common.

The group described here does not include secondary or primary small white kidney. In the terminal stages the clinical state and morbid anatomy of these may be indistinguishable from nephrosclerosis, but the earlier stages of secondary small white kidney are different, and agree in general with origin as a glomerulo-tubular nephritis.

SENILE KIDNEY (*Senile Arteriosclerosis*).—Generally included as chronic interstitial nephritis, but clinically unimportant and pathologically different. Occurs in aged persons as part of generalized senile arteriosclerosis.

MORBID ANATOMY.—

Kidneys.—

Macroscopic: Small or normal size. Capsule thickened and adherent.

Histology: Mönckeberg's fatty degeneration of media of renal vessels. Moderate degenerative changes and increase of fibrous tissue.

Vessels throughout the Body.—Show similar arteriosclerotic changes.

SYMPTOMS.—No renal symptoms or renal inefficiency. Blood-pressure not raised. Albuminuria slight or absent.

Groups of Nephrosclerosis.—Two principal groups:—

1. **ARTERIOSCLEROTIC KIDNEY.**—Kidney of benign hypertension.
2. **RED GRANULAR CONTRACTED KIDNEY.**—Kidney of malignant hypertension.

Pathogenesis.—

ARTERIOSCLEROTIC KIDNEY.—Early stages identical with hyperpiesia (see **ESSENTIAL HYPERTENSION**). Theories of origin are: (1) Hypertension primary, vascular changes secondary (supported by Jores, Loehlein); (2) Renal arteriosclerosis primary, hypertension secondary to ensure separation of urine (supported by Fahr, Herxheimer). On either theory, changes in renal parenchyma accepted as secondary to deficient blood-supply from vascular lesion—i.e., *ischemic nephritis* (Russell).

RED GRANULAR KIDNEY.—Is this essentially a later stage of arteriosclerotic kidney?

IN FAVOUR.—Case recognized as arteriosclerotic kidney (hyperpiesia) over long period may become typical red granular kidney terminally. Morbid anatomy of latter is thus regarded as advanced stage of former.

AGAINST.—Average age at death in red granular kidney is ten years younger than in arteriosclerotic kidney. Evidence exists that histological changes are both inflammatory (toxic) and ischaemic.

CONCLUSIONS.—(1) Red granular kidney can arise without recognizable previous stage of hyperpiesia; (2) Arteriosclerotic kidney may (but not invariably) later develop also the changes of red granular kidney.

I. ARTERIOSCLEROTIC KIDNEY.

(*Essential Hyperpiesia. Benign Renal Arteriolosclerosis* (Fahr).
Ischaemic Nephritis (Russell).

SYNONYMS—See p 625.

Characterized by high blood-pressure and associated vascular changes. Renal manifestations slight.

Etiology.—

AGE.—Between 40 and 70 years, commonly. Average age at death 56 years.

SEX.—Males to females, 2 to 1.

Heredity and obesity common.

PREDISPOSING FACTORS.—See **ESSENTIAL HYPERTENSION**.

Morbid Anatomy.—

1. **KIDNEYS.**—

MACROSCOPIC.—Early: normal or slightly large size. Later: small and granular.

HISTOLOGY.*—

Vascular.—Hypertrophy of intima becoming hyaline, later fibrosis; small arteries and arterioles affected.

* Notes in brackets are additional changes found in red granular kidney.

Arteriosclerotic Kidney—Morbidity Anatomy, continued.

Glomeruli.—(a) Hyaline where arterioles affected; (b) Others normal or hypertrophied. (Affected glomeruli: proliferation of cells, increased nuclei; adhesions to thickened capsule.)

Tubules.—(a) Of affected glomeruli—collapse and later fibrosis; (b) Others normal or dilated.

Connective Tissue.—Replaces destroyed parenchyma. (Extensive areas.)

HEART.—Hypertrophied. May be coronary thrombosis.

CEREBRAL ARTERIES.—Arteriosclerosis often marked.

Symptoms.—Can be described as:—

1. **HYPERTENSIVE.**—Difficulty in concentration; fullness in the head. Flatulence and constipation. Lassitude. Nocturnal frequency. Epistaxis, and various hæmorrhages.
2. **CARDIAC.**—Precordial discomfort and angina; dyspnoea.
3. **CEREBRAL.**—(a) Headache, vertigo, depression, and neurasthenia; (b) Transient paralyses (*see* HYPERTENSIVE ENCEPHALOPATHY, pp. 629, 631); (c) Cerebral hæmorrhage.

Physical Signs.—

BLOOD-PRESSURE.—Not less than 170 mm. systolic and 90 mm. diastolic. Often 200 mm. systolic and 110 mm. diastolic, or higher. Can vary greatly during day. Falls with treatment or cardiac failure.

ARTERIES.—Firm and contracted.

HEART.—Hypertrophied. Aortic second sound accentuated. Premature beats common.

FUNDI.—*Arteriosclerotic retinitis* common, viz., arteries contracted ('silver-wire'), veins dilated, hæmorrhages: no white spots.

Anæmia absent. Polycythæmia (Gaisböck's) not uncommon.

Urine.—*Volume*: normal or increased at night. *Albumin*: trace. *Casts*: occasional hyaline or granular. Few blood-cells.

Blood.—Urea protein and cholesterol normal. Urea clearance and renal efficiency tests normal (water elimination may be deficient).

Prognosis.—Often many years' life, with fair health. (*See* ESSENTIAL HYPERTENSION.)

Mode of Death.—

1. **OTHER THAN RENAL.**—(a) Cardiac failure; (b) Cerebral hæmorrhage, rarely other hæmorrhages; (c) Coronary thrombosis; (d) Intercurrent disease.
2. **RENAL.**—May progress to condition of red granular contracted kidney, renal insufficiency terminating with uræmia or cardiac failure.

Diagnosis.—From malignant type by milder clinical symptoms and course, lower diastolic pressure, and normal renal efficiency tests

Treatment.—Early stage: *see* ESSENTIAL HYPERTENSION. Later stage: *see* RED GRANULAR KIDNEY.

II. RED GRANULAR CONTRACTED KIDNEY.

(*Malignant Renal Arteriolosclerosis. Azotæmic Nephritis. Chronic Interstitial Nephritis.*)

Characterized by high blood-pressure and progressive renal deficiency, with advanced vascular and parenchymatous changes in the kidney.

SYNONYMS.—See p. 625.

Etiology.—

AGE.—Usually between 35 and 55 years. Average age at death, 48 years.

SEX.—Males to females, 3 to 1.

PREDISPOSING CAUSES.—See ESSENTIAL HYPERTENSION.

PHYSICAL TYPES.—(1) Plethoric; (2) Pale and asthenic.

Morbid Anatomy.—**KIDNEYS.—**

MACROSCOPIC.—Small ($1\frac{1}{2}$ to 3 oz. each). Red colour or mottled brown and red. Capsule adherent. Surface rough. Cysts present.

On Section.—Tough. Cortex greatly reduced. Demarcation indistinct. Vessels prominent. Yellow streaks of lipid.

HISTOLOGY.—As in arteriosclerotic kidney, but all changes more advanced and more extensive. Lesions remain irregularly distributed. (See ARTERIOSCLEROTIC KIDNEY.)

HEART.—Hypertrophied.

ARTERIOSCLEROSIS.—Generalized.

Pathogenesis.—The renal and circulatory changes are obviously connected, but relationship is unsettled. Theories are:—

1. **MECHANICAL.**—Renal tissue being reduced, increased blood-pressure is necessary to drive the blood sufficiently fast through what remains. Hypertrophy of heart and arteriosclerosis produce this result.
2. **CHEMICAL.**—The increase of certain substances in the blood, owing to deficient excretion by the kidneys, causes a rise of blood-pressure. The cardiac hypertrophy and arteriosclerosis are secondary to this rise. In support of this, rise of blood-pressure in parenchymatous nephritis is sometimes found without any apparent arterial thickening.
3. **HYPERPIESIA.**—High blood-pressure primary; arteriosclerosis secondary; finally contracted kidney develops.

Symptoms.—**MODE OF ONSET.—**

1. **INSIDIOUS.**—Some initial symptom gradually attracts attention.
2. **LATENT.**—No symptoms until some serious event occurs, e.g., uræmia or cerebral hæmorrhage. Especially as terminal in arteriosclerotic type.

Red Granular Contracted Kidney—Symptoms, *continued*.

INITIAL SYMPTOMS.—One or more of the following: (1) Dyspepsia; (2) Headache and giddiness; (3) Breathlessness and palpitation; (4) Nocturnal frequency of micturition; (5) Failing sight; (6) General weakness, loss of weight, and neurasthenia. Worse in general during night and early morning.

APPEARANCE.—(a) Sallow complexion, tired expression, watery eyes; thin asthenic persons. (b) Plethoric, but losing weight.

GENERAL SYMPTOMS.—**I. URINE.**—

Quantity.—Increased. Often 100 oz.

Frequency of micturition.—Especially nocturnal.

Specific gravity.—Persistently low: 1005 to 1012.

Colour.—Pale.

Albumin.—Usually trace only. Temporarily may be absent, especially in morning urine.

Deposit.—A few casts, hyaline or granular. Leucocytes. Often, red cells.

Urea.—Low percentage.

Chlorides.—Normal or diminished.

The above are characteristic of granular kidney.

Uric acid often forms considerable (cayenne pepper) deposit, possibly due to scanty pigments and salts.

Hæmaturia occasionally marked and persistent.

With onset of uræmia, frequent but not invariable fall in quantity.

With cardiac failure, quantity usually falls and albumin increases, but paleness and low specific gravity remain.

2. CIRCULATORY SYSTEM (changes important).—

Ateries.—Thickened; may be tortuous and atheromatous.

Blood-pressure.—180 to 250 mm. Hg systolic; 110 to 160 diastolic.

Heart.—Signs of hypertrophy.

Cardiac dullness: Increased, but may be masked by emphysema.

Heart-sounds: (1) At mitral area, first sound muffled, or slight systolic murmur (relative insufficiency);

(2) At aortic area, second sound greatly accentuated.

Initial symptoms often cardiac: breathlessness and palpitations, frequently worse on lying down, thus preventing sleep.

Cardiac failure occurs with usual symptoms: dilatation of heart, dyspnœa, œdema, increase of albumin and diminution in urine, often fall of blood-pressure.

3. RESPIRATORY SYSTEM.—Bronchitis common; also emphysema. Attacks of dyspnœa, especially nocturnal (cause may be cardiac or uræmic). Cheyne-Stokes breathing often marked towards end.

Respiratory complications are serious: pneumonia or pleurisy. Rare terminations are œdema of lungs or glottis.

4. DIGESTIVE SYSTEM.—Dyspepsia, nausea, and anorexia rarely absent; especially in morning; may be earliest symptom. Tongue furred and breath heavy. Constipation usual: terminal diarrhoea may be intractable. Vomiting may be severe, even without other uræmic symptoms.
5. NERVOUS SYSTEM.—Headache: usually early symptom, and often severe; may resemble migraine. Giddiness. Tingling of extremities. Neuralgias in various sites. Twitchings and cramps of muscles. Cerebral hæmorrhage not infrequent.
Psychical Symptoms.—Irritability and rapid mental fatigue usual. Delusional insanity occasionally.
6. OCULAR SYMPTOMS.—Often earliest complaint: (1) Dimness and failing vision; (2) Amaurosis—often transient, without retinal changes; (3) Conjunctival hæmorrhages. Diplopia rare.
7. FUNDUS.—*Albuminuric retinitis*—viz., hæmorrhages and white 'cotton-wool' areas in retina; arteries contracted ('silver-wire'); veins dilated. Disc may be swollen and red and edges blurred (papilloedema).
8. OEDEMA.—Only with cardiac failure, but feet may swell. *Conjunctival œdema* common, 'watery eyes' (the tear which never drops).
9. SKIN.—Dry. Complexion muddy. Eczema and itching common. Urea may deposit on skin in late stages ('urea frost'). Certain of the rarer dermatoses may occur in chronic nephritis, e.g., dermatitis exfoliativa.
10. HÆMORRHAGES.—Common; connected with high tension. Epistaxis (often relieves symptoms); conjunctival; retinal; renal; cerebral. Sputum may be blood-tinged.
11. ANÆMIA.—Secondary anæmia, rarely severe.
12. HEARING.—Noises in ear common; may be transient deafness.

Renal Efficiency and Biochemical Tests.—

BLOOD UREA.—Increased, often 50 to 60 mgm. per cent; later rises progressively to high figures.

UREA CLEARANCE AND WATER ELIMINATION TESTS.—Below normal; progressive fall. Specific gravity gradually becomes constant at 1010 to 1012 (*see* p. 622).

BLOOD.—Cholesterol: normal or low. Creatinine: raised, up to 2.5 mgm. per cent. Calcium: may fall to 6 mgm.

Diagnosis.—

CHARACTERISTICS.—Complaints of headache, weakness, dyspepsia, nocturnal frequency of micturition, or failing vision, associated with arteriosclerosis, albuminuria, and retinal changes.

Diagnosis often overlooked, symptoms being referred to individual systems, e.g., gastric.

DIAGNOSIS FROM.—(1) Other causes of frequency of micturition—e.g., enlarged prostate, diabetes; (2) Neurasthenia; (3) Gastritis; (4) Cardiac disease; (5) Chronic bronchitis and asthma; (6) Cerebral lesions (suggested by headache, vomiting, and optic neuritis); (7) Myxœdema; (8) Other causes of uræmia.

Red Granular Contracted Kidney, continued.

Prognosis.—Note: (1) *Age*: more rapid at early ages. (2) *Blood-pressure*: diastolic more important than systolic; serious when over 130. (3) *Condition of heart*. (4) *Albuminuria*: serious if plentiful. (5) *Renal tests*: note increasing insufficiency. (6) *Albuminuric retinitis*: duration rarely exceeds two years.

Course and Progress.—Always progressive, but may be several years of fair health. *Three stages* often recognizable:—

1. **HYPERPIESIA.**—No renal manifestations—i.e., arteriosclerotic kidney. May be absent.
2. **RELATIVE RENAL INSUFFICIENCY.**—Polyuria and low urea concentration, but blood urea not permanently increased.
3. **ABSOLUTE RENAL INSUFFICIENCY.**—Blood urea rising permanently; urea concentration falling.

Complications and Modes of Death.—(1) *Uræmia*; 'pre-comatose state' may be temporarily recovered from (*see pp. 630, 631*). (2) Cerebral hæmorrhage. (3) Cardiac failure; may also complicate uræmia. (4) Intercurrent infections, e.g., pneumonia, pericarditis, pleurisy. (5) Acute exacerbations of nephritis. Rarely: acute œdema of lungs.

Treatment.—No cure is possible. *Indications* are:—

1. To retard progress by removing factors which are contributory and aggravating—viz., over-work, worry, over-eating, alcohol, syphilis, etc. (general treatment).
2. To treat symptoms as they arise.
3. To guard against special sequelæ, cardiac failure, uræmia, and cerebral hæmorrhage.

GENERAL TREATMENT.—Regular life without worry or excesses. Moderate exercise. Warm climate in winter. Avoidance of chills. Bowels freely open. Baths to stimulate skin. Plenty of fluids to drink. No alcohol. Vary directions according to patient's position. Undue severity in early stages may cause mental depression. Course at a spa will control an unruly patient.

Drugs cannot cure. Renal extracts valueless.

DIET.—Moderation important. Light mixed diet. Meat and fish each once daily. Eggs and fruit. Avoid rich foods. As condition advances and blood urea rises, reduce protein to 50 gm. or less.

FLUID.—Three to four pints daily. Occasional glass of hot water. If alcohol insisted upon, whisky and soda or light claret best.

BOWELS.—Carlsbad salts on rising. For stronger aperient pulv. jalapæ co. gr. xv, with pot. tartras acidus gr. xxv, in morning.

HIGH BLOOD-PRESSURE AND HEADACHE.—*See ESSENTIAL HYPERTENSION.* Note: Venesection often contra-indicated by anæmia. Iodides often not tolerated.

TREATMENT OF SYMPTOMS.—

CARDIAC CONDITIONS.—Treat cardiac failure by usual methods.

For a few days, tinct. digitalis ℥x, tinct. nuc. vom. ℥v, t.d.s.; then, if tension high, caffein. citrat. gr. v, t.d.s.

GASTRO-INTESTINAL SYMPTOMS.—General treatment of light diet, free bowels, and stimulation of skin. Usual treatment of dyspepsia.

INSOMNIA.—Medinal or chloral hydrate, gr. v to x.

URÆMIA.—See p. 632.

CHAPTER CVII.

RENAL INFANTILISM.

Retarded physical development, associated with chronic nephritis. Infantilism and rickets may develop.

Etiology.—Sexes equal. No previous rickets or parenchymatous nephritis. No evidence of syphilis as a factor.

Pathogenesis.—Uncertain. Probably several groups. Note: (1) Renal changes: similar to primary small white kidney. (2) Cardiovascular changes: as in primary small white kidney: may be severe or absent. (3) Skeletal changes: may be florid rickets or osteoporosis alone. (4) Biochemistry: usually high inorganic blood phosphorus with relatively low blood calcium. Theory based on this finding is that renal defect produces retention of phosphorus, which forms insoluble calcium phosphate and rickets results from deficient calcium. (5) Parathyroids enlarged in few rare cases with metastatic calcification; latter also recorded without parathyroid enlargement.

Morbid Anatomy.—Kidneys contracted, and changes as in chronic glomerulo-nephritis (small white kidney). No obvious changes in endocrine organs (except rarely parathyroids).

Symptoms.—

ONSET.—Probably in infancy: patient usually small from birth: special symptoms and deficient growth noted at age of 6 years or later. Thirst and polyuria may be early and marked.

URINE.—Amount variable; may be very large, with low specific gravity. Albumin present: amount small, about 1 part in 1000: may be absent. Few hyaline casts.

Cardiovascular Changes.—Two groups: (a) No obvious cardiac hypertrophy, thickening of peripheral arteries, or retinal changes: also normal blood-pressure (perhaps due to dilatation and hypertrophy of urinary tract—Ellis). (b) Changes present and may be severe.

Physical Development.—Growth retarded. Thin. Sexual infantilism in some, but not all. Intelligence normal. Stunting and delayed union of epiphyses may occur without rickets.

Renal Infantilism, *continued*.

Renal Rickets.—Occurs in a few cases only: *tetany* common. Changes as in rickets develop in varying degrees. Radiographs identical with rickets. Knees and wrists most affected; also ankles and costochondral junctions. No bossing of skull. Genu valgum often develops rapidly in second decade. Irradiation aggravates by increasing amount of phosphorus in body (Parsons). (See CALCIUM AND PHOSPHORUS METABOLISM.)

Prognosis.—Usually fatal uræmia in second decade.

CHAPTER CVIII.

AMYLOID DISEASE.

(*Waxy or Lardaceous Kidney*.)

Amyloid disease is not a form of nephritis, nor is it initially a renal degeneration, the material being brought by the blood and deposited in the tissues. General amyloid disease usually present, especially spleen and liver.

Nature of Amyloid.—A glycoprotein containing chondroitin-sulphuric acid; this acid is probably brought by blood, and diffusing through walls combines with a local tissue protein. The name 'amyloid' was given from its brown starch-like reaction with iodine (blue with iodine and sulphuric acid).

Occurrence.—Prolonged suppuration and exhaustion—e.g., chronic osteomyelitis, tuberculosis, syphilis. With modern methods of treatment is rarely seen.

Morbid Anatomy.—

KIDNEYS.—

MACROSCOPIC.—Pale, usually large, smooth; capsule strips readily. Stellate veins injected.

On Section.—*Translucent waxy appearance*. Large cortex; pyramids deep red; differentiation marked; glomeruli distinct. With Lugol's solution (iodine in potassium iodide solution), walnut-brown points form.

HISTOLOGY.—Changes especially in walls of vessels; structureless and homogeneous. Glomeruli most and earliest affected next, afferent and efferent vessels; then other vessels. Epithelium not involved, but glomerular nephritis often coexists. Lipoid deposits usually present.

OTHER ORGANS.—Spleen, liver, and intestines affected usually.

Symptoms.—

1. **PURE AMYLOID KIDNEY.**—Albuminuria is sole sign—moderate quantity; amount of urine normal or increased, with low specific gravity; few casts. CEdema absent or slight. No renal deficiency. Blood-pressure normal. Fundi normal.

2. GENERAL AMYLOIDOSIS PRESENT.—Diarrhœa; liver and spleen enlarged.
3. LIPOID NEPHROSIS ALSO PRESENT (later stages).—Marked œdema and albuminuria, and changes as in nephrosis.

Diagnosis.—Suggested by: (1) Focus of suppuration; (2) Spleen or liver enlarged; (3) Amount of urine large, specific gravity low, Much albumin; (4) No arteriosclerosis; (5) Diarrhœa. Fatal ending invariable in cases where recognized.

Treatment.—Of primary condition.

CHAPTER CIX.

MOVABLE KIDNEY.

(*Nephroptosis.*)

Normal Position of Kidneys.—The kidneys are held in position by: (1) The fatty capsule of 'perirenal fat'; (2) Peritoneal pressure of viscera under tension of abdominal muscles; (3) Renal blood-vessels. Other factors are: (4) Kidney rests in a fossa, which is deeper in males than in females, and deeper on the left than on the right; (5) Layer of areolar capsule is carried up to diaphragm, and stronger on the left; (6) Peritoneal reflections on front of kidney.

Pathogenesis.—Results from defects or changes in above factors. Two important groups: (1) Congenital laxity of abdominal muscles, associated with neurosis, visceroptosis, and general hypotonicity. (2) Acquired; result of repeated pregnancies or (rarely) trauma. Additional factors are loss of weight, constipation. As the kidney descends, the lower pole and outer edge rotate forwards, and then towards mid-line: lower pole becomes most palpable, slips under hand, and accounts for apparent small size of kidney on palpation.

Etiology.—

SEX.—Nearly ten times as common in women. Common both in nulliparæ and multiparæ.

AGE.—Commonest 30 to 40 years.

RIGHT KIDNEY much more frequently affected than left, ascribed to shallow fossa, weight of colon, and possibly to descent of liver on respiration.

FREQUENCY IN WOMEN ascribed to causes given above, occurring in women: fossæ probably shallower.

DEGREES OF MOBILITY.—'Movable kidney' is used for all degrees, but the following are also described:—

1. **PALPABLE KIDNEY.**—Lower pole palpable.

2. **MOVABLE KIDNEY.**—On inspiration, fingers slip over kidney. The occurrence of a true mesonephron is apocryphal.

In practice, amount of displacement and severity of symptoms are often unrelated.

Movable Kidney, continued.

Symptoms.—Affect renal, gastro-intestinal, and nervous systems. When symptoms occur, trauma or strain may excite onset.

TYPES.—

1. **NO SYMPTOMS.**—In majority (80 per cent). When condition detected accidentally, do not inform patient.
2. **LUMBAR PAIN** and dragging discomfort, or rarely intercostal neuralgia. Kidney often tender.
3. **NEURASTHENIA.**—Extreme in congenital group, often absent in acquired.
4. **VISCEROPTOSIS, CONSTIPATION, AND GASTRO-INTESTINAL SYMPTOMS.**—Of all varieties.
Rare: Acute gastric symptoms with epigastric pain and vomiting.*
5. **DIETL'S CRISES.**—Severe attacks, simulating or identical with renal colic. Pain radiating down ureter, shivering, vomiting, scanty urine, perhaps hæmaturia. Local symptoms may be :—
 - a. Kidney tender, but no tumour, though attack may end with passage of much clear urine. Possibly torsion of renal vessels.
 - b. Intermittent hydronephrosis. A renal tumour appears rapidly; disappears after a few days, with discharge of urine. Ascribed to kinking of ureter. Pyelitis or pyonephrosis may also occur.

Pyelitis is common complication.

Diagnosis.—Rarely doubtful.

FROM ENLARGED GALL-BLADDER.—Distinct interval to palpation and percussion between liver and kidney; kidney can be pushed down.

RIEDEL'S LOBE may be difficult.

FROM OVARIAN TUMOUR.—Occasionally.

Treatment.—

INDICATIONS.—According to types of symptoms :—

1. **NO SYMPTOMS.**—No treatment.
2. **RENAL DISCOMFORT.**—Medical, at least 3 months. Surgical, often good results in acquired group, but only indicated in severe cases and with Dietl's crises.
3. **WITH NEURASTHENIA, ETC.**—Solely medical. Surgical, very bad results.
4. **DIETL'S CRISES.**—(a) With intermittent hydronephrosis: Surgical. Treat acute attack as renal colic. (b) Without intermittent hydronephrosis: Medical, at least 3 months.

* Dietl described these acute gastric attacks, and attributed them to the kidney pulling on and kinking the duodenum. But the term 'Dietl's crises' is now invariably applied to renal attacks from kinking of the ureter, which are not mentioned in Dietl's article.

MEDICAL TREATMENT.—*Indications*: (1) Increase body-fat by full diet and tonics. (2) Strengthen abdominal muscles by massage and by exercises (bending, etc., night and morning).

(3) Neurasthenic type: Rest cure. (*See VISCEROPTOSIS*, p. 484.)

ABDOMINAL BELT.—Often gives great relief (by supporting muscles). Should be put on while recumbent or in knee-elbow position, and removed at night. Indication is to raise general pressure: all kidney pads are useless.

SURGICAL TREATMENT.—Fixation of kidney (nephrorrhaphy).

CHAPTER CX.

PYELITIS.

Pyelitis means inflammation of the pelvis of the kidney. All conditions in which bacteria occur in the pelvis of the kidney are referred to in this chapter, except tuberculosis.

Note.—Evidence scanty as to changes in pelvis and kidney in 'pyelitis' of ordinary severity. Probable that renal substance is invariably involved, i.e., condition is 'pyelonephritis' and causes the constitutional symptoms, but is recoverable and not of degree clinically known as 'pyelonephritis'.

Etiology.—Commoner in females: in infants, infection through urethra; in adults, due to pregnancy and constipation. In males: at later ages, enlarged prostate, stricture.

PREDISPOSING CAUSES.—General debility. Cold. Constipation or diarrhoea. After illnesses or fevers. Local causes.

EXCITING CAUSES.—Invasion of bacteria. Rarely: irritation due to turpentine, cubebs, or diabetic urine with secondary infection.

Paths of Infection.—(1) Hæmatogenous; (2) Ascending infection; (3) From surrounding tissues.

1. **HÆMATOGENOUS.**—Through blood-stream. *Associated causes* (may be none): any injury to or disease of renal pelvis—e.g., movable kidney, calculus, pregnancy, pressure of neoplasms, renal operations, hydronephrosis, tuberculosis.

2. **ASCENDING INFECTION.**—From lower urinary tract along peri-ureteral lymphatics (or possibly in lumen of ureter against current). *Associated causes*: interference with normal urinary flow—e.g., enlarged prostate, cystitis, calculus, neoplasms involving ureteric orifice, diseases of nervous system with retention.

3. **SPREAD FROM SURROUNDING TISSUES.**—From bowels in colitis or constipation, other kidney, appendicitis; spreads through lymphatics or blood-vessels.

PREGNANCY.—Frequency of pyelitis in pregnancy may be due to pressure of uterus, dilatation of ureter and pelvis in later months, constipation.

Pyelitis, continued.

Morbid Anatomy.—Mucous membrane of pelvis oedematous and hyperæmic. If obstruction, distension of pelvis and calices with turbid fluid: ureter dilated and thickened above obstruction.

Bacteriology of Urine.—

B. COLI AND COLON GROUP.—Most frequent. Either typical or atypical strains.

STREPTOCOCCUS.—Hæmolytic strains uncommon.

PROTEUS GROUP.

VARIOUS.—Staphylococcus; enteric; gonococcus. Also *B. tuberculosis*, usually in mixed infection.

Symptoms.—Great variety in severity.

ACUTE PYELITIS.—Constipation or diarrhoea may precede onset.

CONSTITUTIONAL SYMPTOMS.—Onset often sudden. Malaise.

Shivering and rigors. Sweats. Vomiting. Pyrexia. Toxæmia marked. Leucocytes: 10,000 to 15,000 per c.mm.

In absence of renal symptoms may simulate septicæmia, e.g., puerperal.

RENAL SYMPTOMS.—Pain and tenderness in loin: severity varies, may be constant or intermittent; occasionally severe as renal colic. Kidney rarely palpable (from local rigidity). Frequency of micturition: may be strangury. Diffuse pain may simulate appendicitis, salpingitis, etc.

TEMPERATURE.—Generally irregular: may rise to 104° with rigors.

URINE.—Turbid. Fishy odour. Deposit: pus, may be blood, epithelial cells, bacteria. May be few hyaline and granular casts.

MILDER FORMS.—Common. Malaise, moderate irregular pyrexia. pain and toxæmia not severe.

CHRONIC PYELITIS.—Often sequel of acute pyelitis. Chronic or recurrent attacks of pyelitis of varying, usually moderate, severity. In intervals may be fair health or constant malaise.

SYMPTOMS.—Malaise, headache, pyrexia, frequency of micturition. May be no local symptoms. Urine as above.

BACILLURIA.—Bacteria may be excreted in urine without causing symptoms or pyuria, i.e., simple bacilluria as in enteric fever.

Note.—*Hæmatogenous origin*: often unilateral. *Ascending pyelitis*: almost always bilateral.

Course and Prognosis.—

ACUTE PYELITIS.—Good in first attack: may be convalescent in two to three weeks. May become chronic. Liability to recurrence is permanent. In ascending pyelitis, may progress to pyelonephritis and pyonephrosis.

CHRONIC PYELITIS.—May be resistant to treatment. Liability to recurrences and exacerbations.

Presence of urinary obstruction impedes sterilization.

PREGNANCY PYELITIS.—Resistant, but usually subsides after puerperium.

Complications.—

1. PYELONEPHRITIS.—Extension of inflammation and suppuration to renal substance. Mainly in ascending pyelitis ('surgical kidneys', 'acute suppurative nephritis').

MORBID ANATOMY.—Multiple abscesses under capsule and in substance. Inflammation of pelvis.

SYMPTOMS.—Severe sepsis, with symptoms of pyelitis.

Rapidly fatal in severe cases. *Urine*: pus, blood, bacteria.

TREATMENT.—Symptomatic.

2. PYONEPHROSIS.—Dilatation of pelvis and calices with pus or pus and urine. Results from infection of pelvis with obstruction to urine, from whatever cause.

SYMPTOMS.—Sepsis, with renal tumour and signs of obstructive lesion (as in hydronephrosis). Toxæmia and symptoms slighter than pyelonephritis, and may be no pyrexia. May be renal insufficiency. *Urine*: pus, and bacteria (but absent if affected ureter blocked).

TREATMENT.—Surgical: nephrotomy or nephrectomy.

Diagnosis.—

WITHOUT LOCAL ABDOMINAL SYMPTOMS.—From septicæmia, especially puerperal and other pyrexial conditions.

WITH LOCAL ABDOMINAL SYMPTOMS.—From perinephric abscess, appendicitis, salpingitis, etc.

PERINEPHRIC ABSCESS.—Tumour, does not move on respiration, irregular shape, tender; no pyuria.

PRESENCE OF PYURIA.—Proves inflammation in urinary tract: diagnosis from posterior urethritis, cystitis, calculus, neoplasm, tuberculosis.

CYSTITIS.—No pyrexia or rigors; bladder but not loin pains; frequency and pain on micturition marked.

POSTERIOR URETHRITIS.—'Two-glass test', viz., urine passed into two glasses; in urethritis 'threads' or turbidity in first only.

METHODS OF EXAMINATION.—(1) Urine for deposit of pus; (2) Cultures of urine; (3) Presence of tubercle bacilli; (4) Descending and ascending pyelograms; (5) Radiographs.

Treatment.—'Cure' claimed only when urine remains sterile after cessation of treatment. Resistant and chronic cases should be investigated fully.

ACUTE AND FEBRILE PYELITIS.—**GENERAL MEASURES.—**

Bed.—Until temperature normal for at least 2 weeks.

Avoid chills.

Bowels.—Freely open but not purged.

Diet.—Not too much milk. No alcohol.

Local.—Antiphlogistine to loins if pain.

DRUGS.—

Alkalis: pot. cit. and sod. bicarb. equal parts, until *urine alkaline*: 30 gr. every 4 hours may be necessary initially or more; pH should be 7·4 to 7·6; slight blue reaction

Pyelitis—Treatment, continued.

to litmus insufficient. Relieves general symptoms but does not cure infection. *Fluids* freely: 4 to 6 pints daily, water, tea, lemonade, Contrexéville water, etc.

Acids.—When temperature normal for several days: (1) Mandelic acid; (2) Acid sod. phosph. gr. 30, with hexamine gr. 10 in mixture t.d.s., or cystopurin gr. 15 t.d.s., or hexyl-resorcinol (caprokol); prolonged periods. *Prontosil.*—Good results recorded.

CHRONIC PYELITIS.—Commence with course of mandelic acid: treatment may be ambulatory. Subsequently keep urine acid. Attention to general health.

RENAL LAVAGE.—Occasionally useful in resistant cases.

VACCINES.—No proof of beneficial effect.

SURGICAL TREATMENT.—Nephrectomy contra-indicated (except in pyonephrosis or occasionally in unilateral pyelonephritis), as other kidney usually involved subsequently or simultaneously.

MANDELIC ACID.—Basis of this treatment is sterilizing action of highly acid urine: has superseded ketogenic diet.

Ammonium Mandelate.—Best preparation at present: given in solution as syrup. Usually sufficient without additional ammonium chloride.

Dosage.—Gr. 45, three or four times daily, after food.

Fluids.—Not more than 2 pints daily.

Reaction of Urine.—pH must be 5.3 or less.

Course.—For 2 weeks. Repeat if necessary. Continue with acid treatment.

Contra-indications.—

1. Febrile stages. Reasons: (a) limited fluid inadvisable, (b) danger of acidosis greater, (c) hyperacid urine causes renal irritation in acute stages.
2. Renal insufficiency: liability to acidosis.
3. Infection with urea-splitting bacteria, e.g., *B. proteus*: urine cannot be acidified by ammonium mandelate.

Results.—Most effective method of treatment. Resistance usually due to urinary obstruction. May be used in infants and children. For *B. coli*, also staphylococcus and streptococcus.

Effect on kidney: may be hyaline and granular casts (due to ammonia) but no permanent damage.

PYELITIS IN INFANTS AND CHILDREN

Commonest under 2 years in females, but males not infrequent. Frequent cause of unexplained pyrexia and rigors.

Onset.—May be acute, with rigor, vomiting, convulsions, and restlessness, progressing to lassitude, drowsiness, or stupor: appears very ill. Temperature high: no regular course. In infants, may be no localizing symptoms: may simulate meningitis.

Insidious Course.—Commoner in older children. May be repeated sudden rises to 104° F., with acute constitutional symptoms for one day or more. Local renal or bladder symptoms severe or absent. In intervals, rapid recovery and health may appear good. Vaginal discharge not uncommon.

Urine.—Highly acid, pus; may be hyaline and granular casts in acute stages. Staphylococcus not uncommon; urine alkaline, mucus in excess.

CHAPTER CXI.

HYDRONEPHROSIS.

Distension of the pelvis and calices of the kidney by non-infected urine as the result of obstruction.

Etiology.—Causal obstruction must be incomplete, intermittent, or gradual, since sudden complete obstruction results in renal atrophy without distension. May be unilateral or bilateral. The causes may be: (1) Congenital; (2) Acquired.

1. **CONGENITAL.**—Ureter twisted or contracted, or inserted into pelvis of kidney or bladder at acute angle or in abnormal position; these include many of the large tumours. Constriction of ureter by abnormal branch of renal artery. In infants, occasionally no obstruction; probably neuromuscular inco-ordination.

Congenital bilateral hydronephrosis usually occurs with other abnormalities—e.g., club-foot—and is fatal in a few days; frequently due to imperforate urethra.

2. **ACQUIRED.**—

- a. **IN LUMEN OF URETER.**—(i) Calculus obstructing ureter, or causing ulceration with subsequent stricture; most common cause. (ii) Tumours of bladder.
- b. **COMPRESSION OF URETER.**—(i) Movable kidney kinking ureter (intermittent form). (ii) Pressure of tumours of ovaries or uterus. (iii) Contraction of cellular tissue following pelvic inflammation. More rarely: bands of fibrous tissue, enlarged lymphatic glands, various tumours and neoplasms.
- c. **BILATERAL HYDRONEPHROSIS** (rarely palpable).—Phimosis. Stricture of urethra. Enlarged prostate. Tumours of bladder (may cause unilateral hydronephrosis).

EFFECTS ON KIDNEY.—Pelvis and calices enormously distended. Kidney finally becomes sac of fluid, lobulated by persistence of the interlobular septa. The renal tissue distends and atrophies, but a small layer is usually present even in advanced cases. The fluid contains salts, a trace of urea, and occasionally of albumin.

Hydronephrosis—Etiology, continued.

There may be adhesions to other organs and compression of colon. Palpable tumour is often absent, but it may be enormous. The opposite kidney may enlarge in compensation.

SEX.—Twice as frequent in women as men, owing to association with movable kidney and pelvic diseases.

AGE.—May occur at any age from congenital causes.

Symptoms.—

TUMOUR.—May occupy most of abdomen; surface smooth or lobulated: tense or elastic, or may fluctuate; in general, resembles renal tumour—viz., bulges into flank, with colon in front; dull to percussion; often painless.

No characteristic symptoms in absence of tumour; there may be obscure abdominal pains, pain in back, with frequency or diminution of urine, or hæmaturia.

INTERMITTENT HYDRONEPHROSIS.—Tumour disappears, with large discharge of urine (rarely noted), and then refills. Caused by movable kidney kinking ureter (with Dietl's crisis).

Diagnosis.—*Intermittency*, when occurring, is diagnostic. *Pyelography*.

1. **LARGE TUMOUR.**—Diagnosis difficult. Occasionally confused with ascites. From *ovarian tumour*: Latter is more mobile, tends to enlarge upwards rather than into flank, colon, and intestines behind, uterus often displaced up and to side.
2. **MODERATE TUMOUR.**—From: (a) *Pyonephrosis*: Pyuria and signs of sepsis. (b) *Perinephric abscess*: Rapid onset, painful, signs of sepsis; no movement with respiration. (c) *Hydatid cyst*. Also *gall-bladder*, *cystic kidneys*, *tumours of kidney*, *Riedel's lobe*.

Prognosis.—Depends partly upon cause.

1. **UNILATERAL.**—Often no symptoms. Size may cause discomfort.

COMPLICATIONS.—(a) *Pyonephrosis* from suppuration; (b) Blockage of sound ureter by calculus, and hence uræmia; (c) Rupture of sac into peritoneum.

2. **BILATERAL.**—Uræmia not uncommon.

Treatment.—No medical treatment. Operate for increasing size of symptoms.

OPERATION.—Aims at removing cause—e.g., by fixation of movable kidney. If sac thin, do nephrotomy and drain, or nephrectomy, but save kidney if possible. In nephrotomy, examine for stone in ureter. Before nephrectomy, measure efficiency of opposite kidney.

CHAPTER CXII.

NEPHROLITHIASIS.

(Renal Calculus.)

The formation of concretions in the kidney or its pelvis.

Occurrence of Calculi and Concretions.—**1. IN THE KIDNEY SUBSTANCE.—**

- a. In new-born children, uric acid particles, at apices of pyramids. Passage may cause crying and priapism.
- b. In gouty and other persons, urates occur at apices of pyramids.
- c. In old people, white deposits of calcium carbonate may be found in the pyramids.

Such deposits in adults cause no symptoms, and all are of little importance.

2. IN PELVIS AND CALICES.—

- a. Renal sand or 'gravel'. Small particles of uric acid passing into urine and forming red 'cayenne-pepper' deposit.
- b. Small stones, single or multiple. Passage causes renal colic.
- c. Single dendritic calculus. May occupy entire pelvis, forming accurate mould of all depressions.

Characters of Renal Calculi.—Calculi causing renal colic are usually $\frac{1}{4}$ to $\frac{3}{4}$ inch in diameter; often pigmented; if multiple, may be faceted. When removed from ureters, are usually either oblong or 'mulberry' calculi.

ON FRACTURE, surface often shows a cortex with concentric rings, and a nucleus. The composition of nucleus may differ from cortex, and the rings may be of different or similar composition.

Chemical Composition of Urinary Calculi.—

1. CALCIUM OXALATE WITH VARYING AMOUNT OF CALCIUM PHOSPHATE.—Commonest calculus in kidney and ureter. Smooth surface, pale, often oblong.
2. CALCIUM OXALATE (pure).—Reddish colour. Irregular surface. 'Mulberry' shape. Very hard and painful.
3. TRIPLE PHOSPHATE (ammonio-magnesium phosphate).—Common in bladder. Rare elsewhere. Large, white, smooth, soft, and very friable.
4. URIC ACID.—Very rare in kidney and ureter, more common in bladder. Smooth, brown, fairly hard. Does not show in radiograph. A trace of uric acid is not uncommon in oxalate or phosphate stones.
5. AMMONIUM URATE.—Hard; brown colour.
6. MIXED COMPOSITION.—Uric acid nucleus, with cortex of other composition. Calcium phosphate may occur in other calculi, or with an outer layer of triple phosphate.

Nephrolithiasis—Chemical Composition of Urinary Calculi, continued.

Rare calculi are:—

CYSTINE.—Large, soft, and 'soapy' to touch. Crystallizes from alcohol in hexagonal plates. (*See CYSTINURIA*, p. 617.)

XANTHINE.—Burns without a flame.

CALCIUM CARBONATE.

UROSTEALITH.

Mode of Formation of Calculi.—Causes not yet ascertained.

Factors of importance in formation of common renal and ureteric calculi are: (1) High acidity, low pigmentation, high concentration of solids; (2) Presence of colloid to form nucleus—e.g., fibrin, mucus from inflammation.

Etiology.—

AGE.—Usually after middle life.

SEX.—Males twice as common as females.

HEREDITY.—Marked in some families.

PREDISPOSING FACTORS.—Excessive diet; sedentary life (common in fat men). Possibly certain drinking waters: thus, is specially common in certain localities, but 'chalky' water is not a factor.

THE TWO KIDNEYS EQUALLY LIABLE.—Occurs on both sides in nearly one-sixth of cases.

Symptoms.—*Acute renal colic* occurs when a calculus tries to enter or move along a ureter which impedes its progress. Calculus may be anywhere in ureter, but most commonly at: (1) Exit from pelvis; (2) Where ureter crosses iliac vessels; (3) Entry in bladder.

ATTACK OF ACUTE RENAL COLIC.—

1. Sudden onset of agonizing pain. May be after exertion or jolting, or without apparent exciting cause.
2. Pain commences in kidney region and radiates down ureter to groin, inner side of thigh, and to testis or labium on same side: testis retracted and tender. No relief in any position.

Note.—May be referred to *opposite side*.

3. Micturition frequent, painful, and bloody (bladder irritable).
4. Nausea and often vomiting. Pulse rapid and feeble. Perspiration. Collapse. Temperature may rise.

DURATION.—One to many hours. Often subsides suddenly.

PAIN.—Often radiates from two renal points on abdomen and back. Pain extremely acute here.

URINE.—May be none during attack. Sometimes much clear urine, possibly from other kidney.

AFTER ACUTE PAIN SUBSIDES.—

1. Dull ache in back over kidney. Often localized to renal points, tender on pressure.
2. Hematuria; rarely profuse; may persist several days. Often some pyuria.
3. The calculus may be passed through urethra.

If other kidney diseased, complete suppression of urine (anuria) and uræmia sometimes occur.

A small rough oxalate stone produces more pain and hæmaturia than larger smooth calculus.

CALCULI REMAINING IN PELVIS OR URETER may cause:—

1. No symptoms—e.g., large dendritic or small fixed calculi.
2. Acute renal colic—possibly by entering ureter.
3. Commonly some of following symptoms:—
 - a. Constant pain in renal region; of varying intensity; may radiate. Sometimes referred to opposite side.
 - b. Hæmaturia for irregular periods, rarely profuse, may be only tinge, relieved by rest. Frequency of micturition. Pyuria.
4. Complications: (a) Pyelitis; (b) Obstruction, whence hydro-nephrosis, pyonephrosis, pyelonephritis; (c) Ulceration.

Pain may simulate sciatica, or be referred to heel or foot.

Oxaluria may cause aching, hæmaturia, and frequency of micturition.

Diagnosis.—Depends upon:—

1. **SYMPTOMS.**—With acute renal colic, often simple: (a) Direction of radiation of pain; (b) Hæmaturia.
2. **PHYSICAL EXAMINATION.**—During acute attack negative. Pressure over kidney may ease pain. Subsequently often tenderness of renal points.
3. **RADIOGRAPHY.**—Usually conclusive, but uric-acid calculus throws no shadow. Include bladder. Simulation of calculi by calcareous glands in line of ureter, and by phleboliths. Pyelography often indicated (ascending or uroselectan).

Differential Diagnosis.—

1. **INTESTINAL COLIC.**—Distribution of pain less definite.
 2. **MOVABLE KIDNEY.**—Dietl's crises may simulate renal colic. Kidney palpable, usually right side and in women.
 3. **BILIARY COLIC.**—Pain in right upper quadrant.
 4. **RENAL TUBERCULOSIS.**—Wasting. Hæmaturia unconnected with pain. Tubercle bacilli in urine.
 5. **CALCULUS IN BLADDER.**—From ureteric calculus often clinically difficult. Urine often alkaline. Radiography and cystoscopy.
 6. **ABERRANT RENAL ARTERY.**—Usually by operation only.
- Note.*—Blood-clot from any cause may produce colic.

Treatment.—

1. **ACUTE RENAL COLIC.**—

Indication is to ease pain. Hypodermic injection of morphia gr. $\frac{1}{4}$ and atropine gr. $\frac{1}{100}$. Continue with belladonna by mouth. Hot drinks of lemonade. Hot poultices to site of pain. Rest in bed until hæmaturia ceases.

2. **BETWEEN ATTACKS.**—(a) Medical; (b) Surgical.

a. **MEDICAL TREATMENT.**—No drug or other treatment can dissolve a calculus.

Nephrolithiasis—Treatment between Attacks, *continued*.

Indications.—(i) Keep urine in condition unfavourable for deposition—viz., low acidity (for oxalates and uric acid); (ii) Diminish excretion of such substances. Regular life. Open bowels. No sudden exertion.

Diet.—Rich in vegetables (vegetable acids are excreted as carbonates). Avoid food with much purins and oxalates, viz.; (i) Purins: rich meats, e.g., sweetbread; (ii) Oxalates: rhubarb, spinach, strawberries, and tomatoes. Whey, a teacupful three times a day, aids excretion.

Fluids.—Daily large quantity of minerals

Drugs.—Reduce acidity with pot. citras; acidity highest in morning urine (no excretion of HCl in stomach); give 3j at night and gr. xx in morning. Test urine, and aim at neutrality, to prevent deposition of phosphates (Langdon Brown).

Spa.—Contrexéville has great reputation for cures.

b. **SURGICAL TREATMENT**.—Operation if calculus is not passed under medical treatment.

Calculi often recur, and, after operation, medical treatment must be followed.

CHAPTER CXIII.

TUMOURS OF THE KIDNEY.

CYSTIC DISEASE OF THE KIDNEY.

PERINEPHRIC ABSCESS.

BENIGN TUMOURS OF KIDNEY AND PELVIS.

Rare: of little importance. Fibroma—most common. Lipoma. Adenoma. Angioma of pelvis: may cause persistent hæmaturia.

MALIGNANT TUMOURS OF PELVIS.

Varieties.—

1. **PAPILLOMA**.—May be benign or malignant. Usually in middle-aged males. *Symptom*: Recurrent painless hæmaturia. *Radiographs*: Filling defect in pelvis with mottled appearance. *Treatment*: Removal of kidney and ureter (in which secondary growth common).
2. **CARCINOMA**.—Very rare. Squamous-celled. Usually large dendritic calculus present, often with hydro- or pyonephrosis.

MALIGNANT TUMOURS OF KIDNEY.

Varieties.—

1. **CARCINOMA**.—Very rare. Tubular adenocarcinoma. White solid mass, no capsule, necrosis rare. No marked increase in size of kidney.

2. **SARCOMA.**—Rare. Spindle-cell or very rarely rhabdomyoma (striped muscle fibres). In infants. Grows to large size. Rapidly fatal.
3. **WILMS' TUMOUR : BLASTOCYTOMA.**—Is a *mixed* tumour with various embryonic tissues present. In infants and children. Grows rapidly to large size. (Also incorrectly termed 'adenosarcoma'.)

4. **HYPERNEPHROMA (GRAWITZ'S TUMOUR).**—

ORIGIN.—Formerly believed to be suprarenal 'rest', since (a) situated just below renal capsule, (b) at upper pole of kidney (doubtful), (c) resembles suprarenal cortex and tumours, (d) does not infiltrate kidney. Now considered to be a true renal adenoma or adenosarcoma. (Cortex of kidney and suprarenal are related embryologically, explaining similarity.) (See also TUMOURS OF THE SUPRARENAL GLANDS.)

MORBID ANATOMY.—(a) Macroscopic: *Yellow opaque areas* (characteristic), with hæmorrhagic and cystic areas. (b) Histology: Polygonal cells with alveolar arrangement in circular columns; general resemblance to suprarenal cortex; much myelin and glycogen.

AGE.—At any age, usually children or at 40 to 50 years.

Unilateral. Grows rapidly and to large size. May invade and grow along renal vein and produce emboli; rarely into renal pelvis. Metastases: in lung, and not infrequent in liver, bones, and also other sites.

In Children.—Retroperitoneal and renal sarcomata and Wilms' tumour are commonest large abdominal tumours.

CHARACTERISTICS.—Age: 3 to 4 years. Early symptoms:

(1) Wasting and anæmia; (2) Abdominal enlargement.

Hæmaturia often absent. Physical signs: unilateral tumours, often very large. Rapid growth. Metastases rare.

In Adults.—

SYMPTOMS.—Metastases may be first indication.

1. **HÆMATURIA.**—Usually is earliest symptom. Often intermittent.

2. **PAIN.**—Variable; may be none, or dragging in loin; severe on passage of clots.

3. **WASTING.**—Usually rapid.

PHYSICAL SIGNS.—

TUMOUR.—(a) Tends to fill flank and then extend towards mid-line; (b) Often movable, but may be fixed; (c) No movement on respiration; (d) Crossed by colonic resonance; (e) Resonance area between tumour and liver or ribs—but absent if tumour very large. May fill half abdomen.

VARICOCELE.—Occasionally tumour penetrating renal vein may obstruct spermatic vein; is suggestive when developing for first time in middle age, especially on right side; does not disappear on lying down.

Malignant Tumours of Kidney, continued.

Diagnosis.—*Characteristics* are: (1) Hæmaturia; (2) Pain; (3) Tumour. *Diagnose*:—

1. By character of tumour, from spleen or liver: if very movable, resembles cancer of ovary.
2. Hæmaturia from other causes.

Radiography (with uroselectan or ascending pyelography) determines affected side. Functional activity of diseased kidney is diminished. The occurrence of portions of neoplasm in the urine is a pathological curiosity.

Treatment.—Nephrectomy. Prognosis very bad. Irradiation.

CYSTIC DISEASE OF THE KIDNEY.

POLYCYSTIC KIDNEYS: CONGENITAL CYSTIC KIDNEYS.

Etiology.—May occur in foetus, obstructing labour. Symptoms most commonly at 40 to 50 years. Probably all congenital. May be familial. May be undiagnosed and found post mortem.

Morbid Anatomy.—*Bilateral*, but one side usually larger than other. Often very large. Surface irregular from protruding cysts.

ON SECTION.—Numerous cysts; contents clear or turbid fluid, containing albumin and phosphates, may be urea; cysts open into each other, but no communication with pelvis or calices. *No obstruction in ureters*. Remnants of renal tissue may be visible, but, even if absent, microscope often shows unexpected amount.

Rarely: Liver and spleen also cystic.

Pathogenesis.—(1) Generally ascribed to remnants of mesonephros (Wolffian body) included in metanephros or true kidney. In infants, there may also be imperforate anus. (2) Less probably: an endothelioma of kidney. No obstruction of ureters present.

Symptoms.—May be none.

1. Bilateral renal tumour: may increase in size.
2. Hæmaturia.
3. Symptoms and signs of chronic interstitial nephritis—thickened arteries, hypertrophy of heart, urinary changes.

Course.—Either tumour or symptoms may first attract attention. Onset usually insidious, but subsequent progress rapid. *Death* in uræmia, cerebral hæmorrhage, or cardiac failure.

Treatment.—Palliative. Operation useless.

VARIOUS CYSTS.

Echinococcus Cysts.

Solitary Cysts.—From dilatation of an obstructed tubule.

Small Cysts in Chronic Nephritis, from obstruction to tubules.

Diffuse Cystic Disease of kidneys, liver, spleen, and sometimes thyroid. Cysts small and not numerous. May be related to congenital cystic disease. Very rare.

PERINEPHRIC ABSCESS.

Suppuration of connective tissue round kidney.

Etiology.—Infection commonly through blood. Occasional local causes are trauma, or extension from kidney, appendix, or spine. A chronic perinephritis, with extensive fibrosis, also occurs.

Symptoms.—Onset often insidious, with signs of sepsis—pyrexia and sweating. *Pain* in lumbar region variable. Hip-joint often flexed. In lumbar region, skin may be red and cedematous: tender on pressure. Leucocytosis. Rarely, pyuria or hæmaturia. *Tumour in loin*: irregular shape, no movement on respiration or palpation.

Diagnosis.—From:—

CARIES OF SPINE.

RENAL TUMOURS.—Usually movable. Hæmaturia.

TUBERCULOUS HIP.—Joint swollen; *resists rotation* as well as extension.

Treatment.—Drainage.

CHAPTER CXIV.**CYSTITIS.**

Inflammation of bladder due to bacterial infection.

Origin and Effects of Bacteria in Bladder.—Bacteria can pass through bladder harmlessly. Predisposing and local causes lead to infection. In absence of these, cystitis (e.g., 'coli cystitis') is usually associated with pyelitis or, less often, posterior urethritis. (*See PYELITIS*, p. 669.)

PATHS OF INFECTION.—

1. DESCENDING.—From kidney—pyelitis or direct from bloodstream.

2. ASCENDING.—From lower urinary tract—by instruments or previous inflammation.

3. BY EXTENSION.—From surrounding structures, *rarely*.

PREDISPOSING CAUSES.—Chill. Debility. Constipation. Alcohol.

LOCAL CAUSES.—Stricture; enlarged prostate; calculus or neoplasm of bladder; diseases of nervous system causing retention; diverticulitis; bilharzia; pelvic tumours and pregnancy; diabetes; passage of septic instruments; injuries.

RARE.—Irritants in urine—e.g., turpentine, cubebs.

Morbid Anatomy.—

IN ACUTE FORM.—Mucous membrane swollen, often covered with mucus, and with numerous ecchymoses. Neighbourhood of trigone and ureters earliest and most affected.

IN CHRONIC FORM.—Fibrosis often leads to contracted bladder. Irregular ulceration and sloughing of mucosa results in thinning of wall, with pouches and trabeculæ.

Cystitis, *continued*.

Symptoms.—Depression. Constipation.

ACUTE CYSTITIS.—Onset often sudden. (1) Pain above pubes and in perineum; (2) Frequent desire to micturate; (3) Agonizing pain in bladder and end of penis on micturition; (4) Pyuria. May be hæmaturia. No pyrexia, sweats, or rigors.

CHRONIC CYSTITIS.—Similar but less marked symptoms. Usually secondary to acute cystitis, but onset may be gradual—e.g., in retroverted gravid uterus.

Diagnosis, Diagnostic Methods, Condition of Urine, Bacteriology.—See PYELITIS, pp. 667–671.

Treatment.—See PYELITIS, p. 669.

LAVAGE OF BLADDER.—Consider in cases resistant to treatment. Not in acute stages and while micturition is painful.

CHAPTER CXV.

TUBERCULOSIS OF URINARY TRACT.

I. TUBERCULOSIS OF THE KIDNEYS.

Etiology.—

MODE OF ORIGIN.—In fatal phthisis there may be foci in kidneys, and in generalized tuberculosis often some miliary tubercles of no clinical importance. *Clinical renal tuberculosis* may have origin:—

1. THROUGH BLOOD-STREAM.—Often secondary to slight pulmonary focus or chronic bronchial gland. Rarely is primary.
2. THROUGH ASCENDING INFECTION.—From bladder, prostate, epididymis, etc. Rare.
3. Direct spread from tuberculous vertebra has occurred.

AGE.—Commonest, 20 to 30 years.

SEX.—Males commoner than females.

Morbid Anatomy.—Surface of kidney may appear normal.

IN BLOOD INFECTIONS.—

- a. Commences at base of pyramid in upper or lower pole. Caseous nodule forms, tends to soften and to burst into pelvis; hence ragged cavity; pyelitis may follow; tuberculosis tends to spread down ureter. Nodules may be multiple, some being caseous and some ruptured.
- b. Less commonly, commences in pelvis and attacks pyramids: or ureter chiefly affected being infiltrated and thick.

IN ASCENDING INFECTIONS.—Lower pole usually attacked, spreads inwards from apex of pyramid. Ureter thickened.

Nodules spread by formation of surrounding miliary tubercles, which grow and coalesce.

Intervening renal tissue may be healthy, fibrosed, or occasionally show changes of nephritis.

Nearly always attacks one kidney first, affection of other following much later.

PROGRESS OF DISEASE.—Many months or several years before kidney is destroyed.

RESULTS may be :—

1. Kidney forms sac containing thick putty-like material.
2. Fibrosis marked : pelvis and capsule thickened, scattered caseous nodules.
3. Pyonephrosis : from blocking of ureter with tuberculous growth.
4. Ureter thickened and ulcerated.

Other changes may be :—

Secondary infection with pyogenic bacteria.

Spread down ureter to bladder, vesiculæ seminales, testes, prostate : in late case with widespread disease, primary focus often doubtful.

Glands in hilus enlarged.

Adhesions to surrounding structures.

Symptoms.—

1. **FREQUENCY OF MICTURITION.**—Night and day. Most frequent early symptom. Becomes urgent and painful. Due to : (a) Polyuria ; (b) Non-tuberculous inflammation of trigone ; and partly to reflex irritation.
2. **PAIN.**—May be : (a) Renal—dull ache in loin : frequent. (b) Bladder—at end of penis : from passage of tuberculous matter, even before bladder affected. Ureter may be blocked.
3. **PYURIA.**—May be absent at times if ureter blocked.
4. **HÆMATURIA.**—Slight, except early : rarely, profuse from pelvis.

In unilateral disease.—General health fair.

In bilateral disease.—Constitutional symptoms more marked, irregular pyrexia, rigors, loss of weight. Phthisis common.

Physical Signs.—Often no local renal signs. Occasionally : (a) Tenderness on pressure. (b) Kidney palpable—unusual : large tumour rare except with pyonephrosis. Tuberculous nodules may be palpable in testes, vesiculæ, or ureters (per rectum).

Urine.—*Amount* increased ; *specific gravity* low ; *colour* pale ; *reaction* acid ; *pus* varies, often settles in white layer, leaving urine clear ; *blood* usually absent ; *casts* rare. Sterile. Tubercle bacilli may be present. In early stages may be no change except slight albuminuria.

Diagnosis.—Questions arising are : (1) Is renal tuberculosis present ? (2) Which kidney is affected ? (3) What is condition of other kidney ? (4) What is condition of genito-urinary tract ? (5) Is tuberculosis present elsewhere ?

PRESENCE OF RENAL TUBERCULOSIS.—

- a. **SUGGESTIVE SYMPTOMS.**—(i) Frequency of micturition without arteriosclerosis ; (ii) Pyuria ; (iii) Tuberculosis of testis, vesiculæ seminales, prostate, or lungs.
- b. **TUBERCLE BACILLI IN URINE.**—(Tubercle bacilli may possibly occur in urine without renal tuberculosis ; hence bacilli, in absence of pus and symptoms, would not *prove* renal tuberculosis.)

Tuberculosis of the Kidneys—Diagnosis, *continued*.

CONDITION OF EACH KIDNEY.—

- a. **CYSTOSCOPY.**—(i) Pus issuing from ureter may be visible ;
(ii) If ureter involved, ureteric orifice is red, dilated, and is displaced outwards by contraction of fibrous tissue in ureter ; (iii) There may be tubercles locally in bladder.
- b. **CATHETERIZATION OF URETERS.**—Urine examined from each kidney : injection of indigo-carmin or phenol-sulphonephthalein previous to catheterization.
- c. **RADIOGRAPHY.**—Tuberculosis gives indefinite shadow.

EXAMINATION OF TESTIS, PROSTATE, VESICULÆ SEMINALES, AND URETER.—Also of lungs.

ABDOMEN, THORAX, SPINE.—Examine for calcified glands and signs of tuberculosis.

Course.—Never heals. Gradual increase of toxæmia, renal inefficiency, and liability to secondary infection.

Treatment.—

INDICATIONS FOR OPERATION.—(1) Unilateral disease ; (2) Pyonephrosis, even with some disease in other kidney.

CONTRA-INDICATIONS.—(1) Bilateral disease ; (2) Tuberculosis elsewhere *causing constitutional symptoms*.

WHEN OPERATION IS CONTRA-INDICATED.—Treat as tuberculous cystitis (*see below*).

Prognosis after Operation.—If bladder unaffected, and no disease in epididymis, vas, or prostate, prognosis is good, but other kidney may become infected at any interval subsequently.

II. TUBERCULOSIS OF THE BLADDER.

(*Tuberculous Cystitis.*)

Most common in young males. *Always secondary* to tuberculosis of kidney, epididymis, or possibly prostate. Spreads along lymphatics of ureter or vas, which become thickened.

Morbid Anatomy.—

EARLY.—Tubercles form, caseate, and form ulcers covered with slough and surrounded with gray tubercles.

SITE.—(1) *Around ureteric orifice*, secondary to kidney ; (2) Outer side of ureter, secondary to epididymis.

LATER.—*Fibrosis causes extreme contraction of bladder*. Perforation very rare. Secondary infection may occur, ulceration marked, and phosphatic deposits.

Symptoms.—(1) Frequency of micturition, especially at night.
(2) Pain in bladder and end of penis on micturition. (3) Urine pale, acid, clear or purulent ; blood not common.

Diagnosis.—

METHODS.—(1) Examination of urine for tubercle bacilli and pyogenic organisms; (2) Condition of epididymis and vas, and of kidneys and ureter; (3) Cystoscopy.

DIAGNOSIS FROM.—Other causes of cystitis, and from pyelitis, calculi, neoplasms, *Bilharzia*.

Prognosis.—Grave.

1. When primary focus is removed, small lesion occasionally heals, but often relapses.
2. Progressive, commonly; bladder contracts; finally back-pressure to kidneys, and uræmia.
3. Rapid extension and complications: fistulæ, secondary bladder infections, tuberculous peritonitis, general tuberculosis.

Treatment.—

OPERATION.—Removal of primary focus, kidney or testis, with ureter or vas. (Exclude bilateral renal tuberculosis previously.) General measures to maintain health.

Operations on bladder and all local treatment of bladder valueless. Drugs useless.

III. TUBERCULOSIS OF THE PROSTATE.

Frequent in genito-urinary tuberculosis, but rarely if ever primary.

Symptoms.—(1) Pain and frequency of micturition; (2) Pain on defæcation; (3) Extreme pain on catheterization. Symptoms may be latent, discovered on routine examination in genito-urinary tuberculosis.

Physical Signs.—*Per rectum*: nodules in prostate; fairly hard; may be unilateral. Examine epididymis, vas, etc., for signs of tubercle. Massage prostate and examine secretion for tubercle bacilli and pus.

Diagnosis.—Usually by other genito-urinary tuberculosis. (a) From gonorrhœa: presence and examination of discharge, epididymitis. (b) From cancer: neoplasm much harder.

Treatment.—Remove primary disease by operation. Sedatives for bladder.

IV. TUBERCULOSIS OF THE TESTIS AND EPIDIDYMISS.

Etiology.—(1) *Primary*: not uncommon. (2) *Secondary* to genito-urinary or other focus. Presence occasionally diagnoses an obscure tuberculous peritonitis.

AGE.—May occur in infants, when prognosis is bad owing to generalization.

INJURY.—Often calls attention to nodule; no definite proof of causation.

Tuberculosis of the Testis and Epididymis, *continued*.

Morbid Anatomy.—Commences in *globus major* of epididymis; nodule forms; spreads through epididymis, which becomes irregularly thickened round testis; then along vas to remainder of genito-urinary tract. Testis often free until late stage. Caseation and softening may produce cold abscess, which becomes adherent to scrotum and bursts.

Symptoms.—Usually no symptom until attention attracted by pain on casual pressure; testicular sensation remains.

Signs.—Nodule in *globus major*, unilateral at onset; chronic progress slow. Later, entire epididymis becomes thickened, hard, and irregular. Small hydrocele common. Spread along vas gives sensation of 'beading'. Testis rarely much enlarged.

Rarely: Acute onset with pain.

Diagnosis.—From:—

1. GUMMA.—Affects testis. Testicular sensation diminishes. Improves with antisyphilitic treatment. Wassermann reaction positive.
2. GONORRHOEA.—Affects *globus minor* initially. Presence and history of discharge.
3. NEOPLASM.—Affects testis and epididymis. Rapid growth.

Treatment.—Not uncommonly heals under general treatment.

OPERATION.—

INDICATIONS.—Condition spreading under treatment; vas affected. Early stage, partial epididymectomy. Later, remove testis and vas so far as possible.

CONTRA-INDICATION TO OPERATION.—Extensive disease elsewhere.

Section VIII.—DISEASES OF THE BLOOD AND SPLEEN.

CHAPTER CXVI.

NORMAL BLOOD.

Normal Blood Picture.—In a healthy adult male, age 20 to 40 years, the following figures are normal:—

Red cells (erythrocytes) ..	5,500,000 to 6,000,000 per c.mm.
Hæmoglobin ..	95 to 100 per cent
Colour index ..	0·8 to 0·9
White cells (leucocytes) ..	5000 to 9000
Platelets ..	200,000 to 350,000 per c.mm.

Differential Count of White Cells:—

Polymorphonuclear neutrophils	50 to 75 per cent
Eosinophils or coarsely granular oxyphils	2 to 3 per cent
Mast cells or coarsely granular basophils	0·1 to 0·5 per cent
Large mononuclears (hyalines, monocytes)	4 to 8 per cent
Small lymphocytes .. 15 to 25 per cent	20 to 35 per cent
Large lymphocytes .. 5 to 10 per cent	

Results in an ordinary count of 500 white cells are probably accurate within ± 10 per cent. Figures in the first place of decimals are valueless.

The Colour Index is a measure of the amount of hæmoglobin contained in each red cell compared with the normal amount. It is calculated thus:—

$$\frac{\text{Hæmoglobin per cent}}{100} \div \frac{\text{Number of red cells}}{5,000,000}$$

(For comparison, 5,000,000 per c.mm. is used as standard.)

NOTE.—Red cells in healthy female about 5,000,000 to 5,500,000. The 'normal' figures for both male and female are often exceeded, and 6,500,000 to 7,000,000 is not unusual. *Hæmoglobin*: normal about 16 gm. per 100 c.c. with 5,500,000 red cells. The standards used in various hæmoglobinometers differ considerably.

Coagulation Time.—Varies in a given case: (1) Rapidly in first few successive drops; (2) With temperature of observation. At 37° C. as follows:—

	Mean	Limits
1st drop	130 sec.	100–170 sec.
2nd „	65 „	
3rd „	45 „	
4th and subsequent drops ..	40 „	25–55 „

Acceleration probably due to products of bruised tissues and later to gathering platelets. Estimation by Dale and Laidlaw's and by Gibbs's methods.

Normal Blood, *continued*.

Fragility of Red Cells.—Haemolysis normally commences in NaCl solution about 0.45 per cent; complete about 0.40 to 0.35 per cent.

Bleeding Time (Duke's Test).—A deep prick with cutting needle or small cut is made in ear. Blood is soaked off without pressure on filter paper every 20 seconds, until cessation. Normal: 1 to 2½ minutes.

Capillary Resistance Test (Rumpel-Leede's).—Arm constricted with sphygmomanometer armlet at diastolic pressure for 2 minutes: normally no petechiae are produced. (Much longer and high pressures can be normally withstood, but this is advisable standard.)

Size of Red Cells.—Red cells normally vary in size somewhat in a given individual. Average normal mean diameter = 7.2μ . Limits of mean diameter in different persons = about 6.9 to 7.5μ .

PRICE-JONES' CURVE.—The number of cells which are smaller and larger than the commonest size are equal; if plotted for size and percentage, the curve is *symmetrical*.

Sedimentation Rate.—Rate of sedimentation of red cells in citrated blood. Due to complex factors. Standards of normal fixed for different methods (usually Westergren). *Delayed* especially in: cachexia, phthisis, allergy, and anaphylaxis. *Accelerated* especially in: severe anæmias and blood diseases, infections, and inflammations. No value in diagnosis, but useful in judging progress in phthisis.

CHAPTER CXVII.

GENERAL CONSIDERATION OF DYSHÆMOPOIETIC ANÆMIA.

Anæmia means a reduction in the hæmoglobin or erythrocytes of the blood. Also applied to the symptoms resulting.

Reduction in hæmoglobin is the essential feature. Erythrocytes in milder grades, e.g., moderate chlorosis and microcytic anæmia, may be reduced only in size and volume; but in all severer grades also in number.

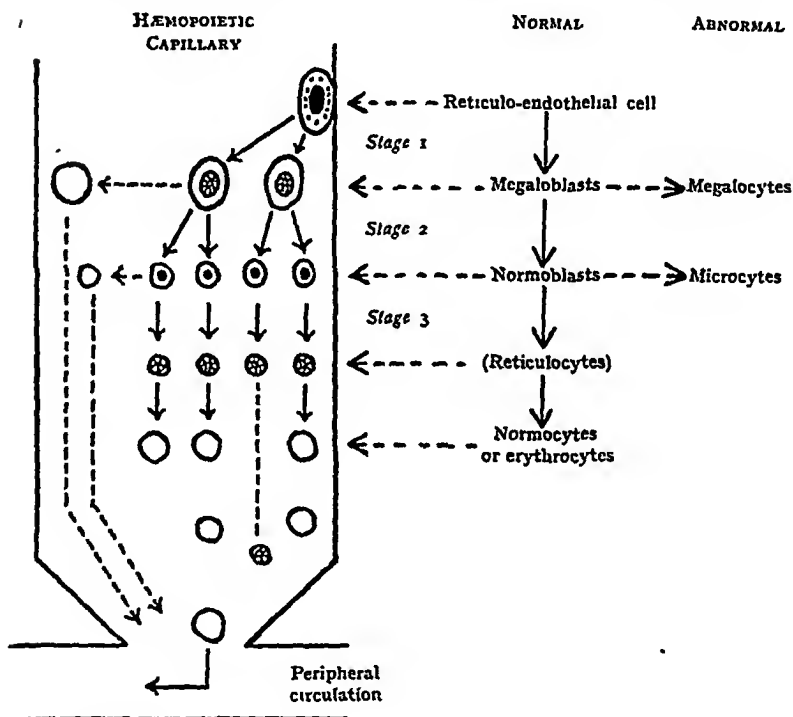
Erythrocytes tend to maintain normal full-saturation with hæmoglobin both when larger or smaller than normal, but in severe microcytic forms there may be under-saturation. Super-saturation is not recognized.

Causes of Anæmia.—(1) *Deficient or defective formation of red cells or hæmoglobin* ('dys hæmopoiesis', Wits); (2) Destruction of cells in the body (haemolysis); (3) Removal of blood. The first cause is alone discussed in this chapter.

Deficient or Defective Formation of Red Blood-cells.—Knowledge of factors influencing formation of red cells is important for appreciating development respectively of megalocytosis (macrocytosis) and microcytosis, and the relations of the two forms.

Advances have followed specially from: (1) Discovery of action of liver* in pernicious anæmia; (2) Price-Jones's study of size of red cells; (3) Recognition of importance of gastric secretion.

Normal Development of Red Cells.—Red cells develop *within* capillaries in the bone-marrow, originating from cells lining the walls, probably reticulo-endothelial. Progress may, provisionally, be regarded as in definite stages, as shown in the following diagram. (Megalocytes do not form normally during life.)



Notes.—

1. Many megaloblasts can probably develop from a single parent cell, and many normoblasts from a single megaloblast.
2. Normoblasts are smaller than megaloblasts and smaller than final ripe erythrocytes (normocytes).
3. Megaloblasts may form megalocytes if normal development of normoblasts is impeded.
4. Normoblasts may form microcytes if normal development of erythrocytes is impeded.
5. Some 'stickiness' normally prevents megaloblasts and normoblasts from entering the peripheral circulation.

* In the chapters on anæmia 'liver' is frequently used to include hog-stomach preparations.

Normal Development of Red Cells, *continued*.

THREE STAGES are thus recognizable:—

1. RETICULO-ENDOTHELIAL STAGE.—Development into megaloblasts. Interference produces *aplastic or normocytic anæmia*.
2. MEGALOBlastic STAGE.—Development into normoblasts. Interference produces *megalocytic anæmia*.
3. NORMOBlastic STAGE.—Development into erythrocytes. Interference produces *microcytic anæmia*.

Interference at Reticulo-endothelial Stage: Aplastic or Normocytic Anæmia.—No knowledge of factors influencing development into megaloblasts. Interference results essentially in: (1) General reduction of red cells without qualitative changes (later stages are normal); (2) Hæmoglobin proportionately diminished. Colour index varies round normal.

Interference at Megaloblastic Stage: Megalocytic Anæmia.—Normal development in the marrow from megaloblastic to normoblastic stage needs activity of a substance first recognized in liver, a specific hæmopoietic substance often referred to as 'P.A. (pernicious anæmia) factor' or hæmopoietin. Absence of this substance results essentially in *megalocytosis*.

CHARACTERISTICS OF MEGALOCYTOSIS.—

1. Megaloblasts, hindered from normal development, produce a certain number of megalocytes which enter the circulation, thus causing increase in the average size (megalocytosis) with reduction in total numbers owing to lack of formation of normoblasts.
2. Hæmoglobin falls as to total amount.
3. Colour index rises from increased proportion of hæmoglobin-saturated megalocytes.

Megaloblasts are almost invariably present in blood. Normoblasts absent in pure forms.

The clinical entity of pernicious anæmia may exhibit pure megalocytosis without normoblastic abnormalities.

THE HÆMOPOIETIC SUBSTANCE OR P.A. FACTOR.—The mode of formation of this anti-anæmic substance was elucidated by the successive discovery of the curative powers in pernicious anæmia of various preparations which are summarized as follows:—

Active by Mouth.—Approximate order of discovery:—

1. Liver.
2. Liver extract.
3. Hog's stomach: mucosa and muscularis.
4. Gastric juice digested with beef.
5. Gastric juice with yeast (vitamin B₁ and B₂).
6. Gastric juice with heated yeast (vitamin B₂).

Active on Injection.—Liver extract.

Inactive on Injection.—Dried hog's stomach.

Inactive.—

1. Layers of hog's stomach separately.
2. Gastric juice alone.
3. Yeast alone.

PRODUCTION OF HÆMPOIETIC SUBSTANCE.—Hæmopoietic substance is thus produced by interaction of :—

- a. *Intrinsic Factor.*—Secreted from pyloric end of stomach, and duodenum, probably by Brünner's glands. Is probably a ferment but not rennin or pepsin. Secretion is prevented by some unknown lesion which also causes achlorhydria. Is inactive on injection.
- b. *Extrinsic Factor.*—Nature unknown; is not vitamin B complex, but closely associated with it: present in most mixed diets.

ABSORPTION AND STORAGE OF HÆMPOIETIC SUBSTANCE.—Is normally absorbed from small intestine; absorption of pharmaceutical preparations not very efficient—are 50 times more potent on injection. Is stored in liver, also kidneys and other solid organs: hence present in various animal and fish livers. Storage may be prevented by disease of liver, e.g., cirrhosis, and by certain ill-defined defects.

MEGALOCYTIC ANÆMIA.—Develops if amount of hæmopoietic substance reaching bone-marrow and acting efficiently is defective. Deficiency may result from: (1) Intrinsic factor; (2) Extrinsic factor; (3) Absorption from intestine; (4) Errors of storage. More than one of these factors may be present simultaneously. Further, is often complicated by simultaneous presence of microcytic anæmia; and sometimes by partial aplasia.

Interference at Normoblastic Stage: Microcytic Anæmia.—Normal development from normoblasts to erythrocytes needs a supply and absorption of iron, such that the amount absorbed into the body and efficiently acting in the marrow is sufficient to ensure enough hæmoglobin to saturate completely the full normal complement of red cells. Amount of iron in food is only just in excess of body's need with normal absorption. (Traces of copper and other minerals, thyroxine, and vitamin C are also necessary.)

RESULTS OF DEFICIENCY OF ABSORBED IRON:—

1. Fall of hæmoglobin.
2. Microcytosis. The total number of red cells may be about normal—e.g., in moderate chlorosis, a pure microcytic anæmia. In other cases the total number is lessened in addition to the size being reduced.
3. Colour index low. The result of microcytosis. Occasionally the cells are no longer hæmoglobin-saturated, and the colour index then falls very low.

MICROCYTIC ANÆMIA.—Develops if iron is deficient for the normal or for special demands. Deficiency may result from: (1) Excessive demands, e.g., hæmorrhage; (2) Faulty diet; (3) Faulty absorption. Iron is absorbed mainly in first fifteen inches of intestine from pylorus, and better in acid than alkaline reaction. Absorption is thus interfered with (a) by achlorhydria, (b) possibly by hyperchlorhydria, if causing too rapid passage of contents, and (c) by general disturbance of intestinal absorption.

Microcytic Anæmia, continued.

Initial change may be microcytosis without reduction of numbers, as in chlorosis. Number falls in severer grades and may do so from onset. Normoblasts may be present when number considerably reduced.

Condition reacts to iron, maybe completely, but depends on cause.

Interference at all Stages.—Certain substances and factors are necessary for formation of blood efficiently at all stages. Little known, but include thyroxine, calcium metabolism, and probably vitamin C. Exhaustion of marrow may occur from persistent over-demands or from toxic action of other diseases. Bone-marrow may be mechanically reduced by tumours, etc. (see LEUCO-ERYTHROBLASTOSIS, p. 742).

Reticulocytosis.—Reticulocytes are slightly immature erythrocytes which mature in circulating blood: they are present in normal blood up to about 1 per cent of total red cells. Formerly recognized with Romanowski stains as 'punctate basophilia'.

INCREASE OF RETICULOCYTES.—Accompanies increased delivery of red cells from the marrow into the circulation. It thus occurs temporarily in *any type of anæmia* during improvement or remission; the rise may be large and constitute a 'reticulocyte crisis' in cases of deficiency anæmia in which the marrow has become hyperplastic. May occur *persistently* in conditions of constant increased demands for red cells without interference in normal course of formation, e.g., hæmolytic jaundice. *Reticulocytosis* is thus seen in:—

1. Hæmorrhage, if acute and considerable.
2. Chronic microcytic anæmia, during *improvement* under iron. Rise depends on deficiency of red cells and not of hæmoglobin. May be 'reticulocyte crisis' if reds under 3,000,000 in iron-deficiency forms.
3. Megalocytic anæmia. Characteristically observed in pernicious anæmia at commencement of treatment (see p. 704).
4. Hæmolytic anæmia, e.g., acholuric jaundice.

PERSISTENT HIGH RETICULOCYTE COUNT AFTER TREATMENT.—Evidence that condition is not being neutralized by treatment.

Reticulocytes are low in many forms of secondary and symptomatic anæmia (formation of red cells diminished), and usually in aplastic anæmia (may be 5 per cent).

Failure of Gastro-duodenal Secretion.—A gastric lesion producing achlorhydria and microcytic anæmia may not abolish the intrinsic factor (produced also in duodenum): illustrated by resections and neoplasms of stomach and atrophic gastritis. But the unknown lesion which abolishes the intrinsic factor always (simultaneously or previously) produces achlorhydria.

Combinations of Megalocytio and Microcytic Anæmia.—Of the two factors, hæmopoietic substance and iron: (a) Each factor may be deficient separately, either *completely or partially*;

(b) Both factors may be absent or deficient together, tending to produce both types of anæmia simultaneously; (c) Both factors may fail together, or one follow the other, in either order, and the failure of either may be partial or complete. Various combinations thus occur, especially seen in defects of diet or absorption. Thus celiac disease may exhibit various combinations of anæmia, either in one case at different stages, or in different cases.

Both types may require separate appropriate treatment, initially the megalocytic; the causal condition, e.g., celiac disease, requiring separate treatment. An initial blood transfusion may be necessary.

When the megaloblastic intrinsic factor is absent, resulting in megalocytic anæmia, a reduced amount of iron is sufficient for the amount of hæmoglobin which can be used: a certain amount of 'free iron' is thus stored in the tissues. Full recovery of pernicious anæmia on liver alone may be due to use of the stored 'free iron' previously unusable. In some cases of pernicious anæmia, and commonly in other megalocytic anæmias, microcytic anæmia develops during treatment, i.e., with need for more iron, and thus calls for treatment with iron.

General Diagnosis of Anæmia.—

1. **INSPECTION.**—Must always be confirmed by examination of blood. Colour of cheeks no guide: fever, excitement, sunburn, natural complexion, may mask anæmia. Mucous membranes better guide, but often misleading. Sallowiness from constipation, acute alcoholism, etc., or natural complexion, often simulates extreme anæmia, even of mucous membranes.
2. **EXAMINATION OF BLOOD.**—Less than 5,000,000 red cells per c.mm. with less than 90 per cent hæmoglobin is anæmia.
3. **SPLENOMEGALY.**—Moderate grade may occur in any chronic anæmia.

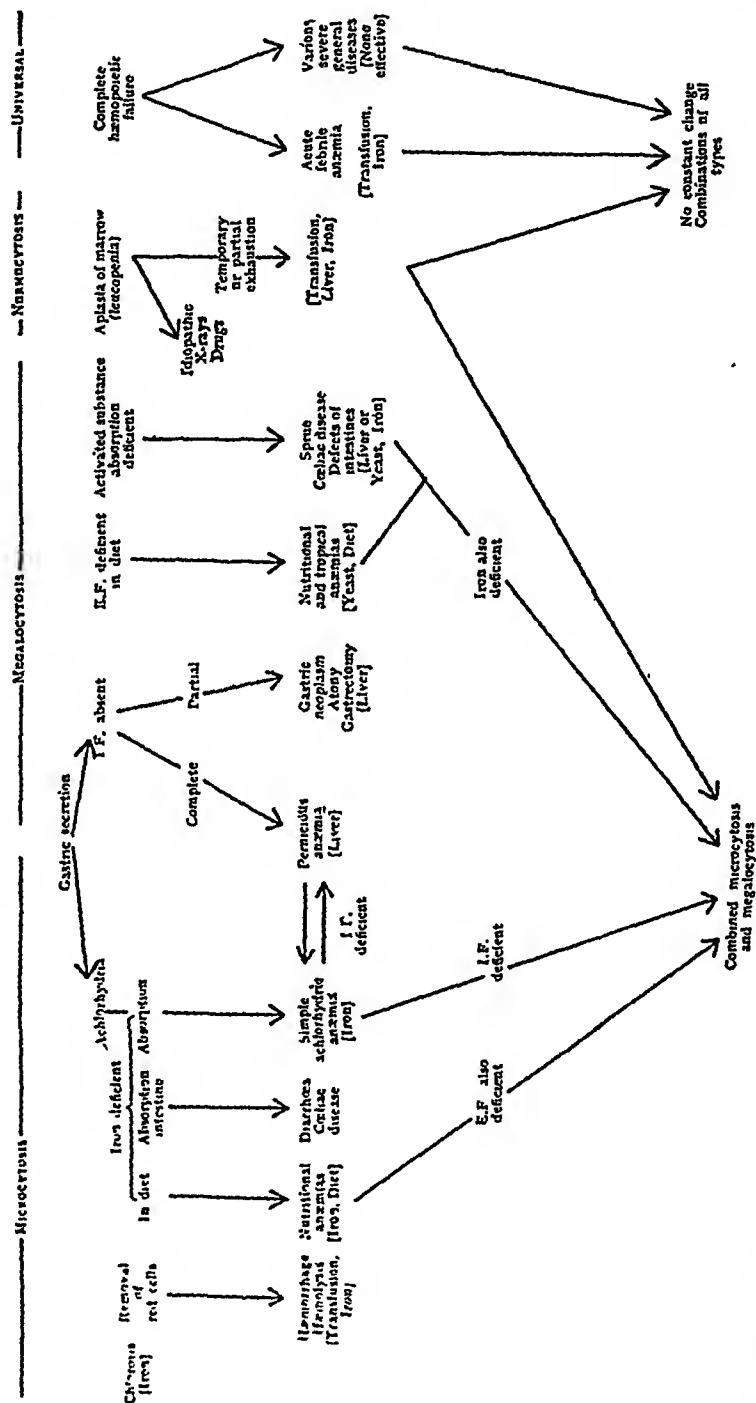
CHAPTER CXVIII.

CLASSIFICATION AND TYPES OF ANÆMIA.

Classification.—Anæmias were formerly divided into: (1) Primary—no recognizable cause; and (2) Secondary—a recognizable disease or cause present. Modern advances prove that the division is unsound, as causes are known for conditions classified formerly as primary. Secondary anæmias were considered to be characterized by a low colour index, and the term is still used in this sense but should be replaced by 'microcytic' or 'hypochromic' anæmia.

The classification here given is partly etiological, but knowledge is still insufficient for this to be complete and consistent. A heading 'secondary or symptomatic anæmia' is retained for convenience, which in effect includes the general symptoms of

CHART OF THE ANÆMIAS.



I.F. = Intrinsic factor
E.F. = Extrinsic factor
Essentials of treatment in brackets

microcytic anæmias however produced, and a list of conditions which cause such anæmias, most of which are considered under separate headings. The causal conditions may be easily recognizable diseases or factors, or, on the other hand, ill-defined toxæmias.

1. HÆMORRHAGE.—(a) Acute; (b) Chronic.
2. SECONDARY AND SYMPTOMATIC ANÆMIAS.
3. DEFICIENCY DYSHÆMOPOIETIC ANÆMIAS.—Interference with blood formation.
4. HÆMOLYTIC ANÆMIAS.—Increased blood-destruction. (See p. 709.)
5. HÆMORRHAGIC DISEASES.—Increased blood-loss. (See p. 716.)

Many forms of anæmias cannot at present be classified.

1. Anæmia due to Hæmorrhage.—Acute and chronic. See pp. 695, 696.

2. Secondary and Symptomatic Anæmias.—Causes:—

a. HÆMORRHAGE.—Conditions opening large vessels, or constant loss of small amounts. Trauma. Gastric, duodenal, or typhoid ulcers. Hæmorrhoids. Gastric and intestinal neoplasms. Menorrhagia. Uterine fibroid. Post- or ante-partum hæmorrhage. Tubal pregnancy. Aneurysm. Hæmophilia. Hæmorrhagic diathesis. Hook-worm disease.

b. INTERFERENCE WITH THE RECEPTION, ABSORPTION, AND UTILIZATION OF FOOD.—Starvation. Deficiency anæmias. Neoplasms. Chronic nephritis. Chronic sepsis.

c. HÆMOLYSIS.—(i) In certain blood diseases, e.g., acholuric jaundice. (ii) Protozoal infections: malaria, blackwater fever, oroya fever. (iii) Bacterial infections: *B. welchii*, hæmolytic streptococci. (iv) Toxic: snake venom, various drugs.

d. CERTAIN INFECTIONS.—To some degree in most specific fevers.

e. BLOOD DISEASES.—Numerous, e.g., splenic anæmia, leukæmia.

f. INTOXICATIONS AND DRUGS.—Many inorganic and organic substances, e.g., lead, mercury, arsenic, and other heavy metals; trinitrotoluene and other benzol derivatives. Applications of X rays and radio-active substances.

g. LEUCO-ERYTHROBLASTIC ANÆMIA.—Tumours, etc., involving the marrow.

3. Deficiency Dyshæmopoietic Anæmias (*Interference with Blood-formation*).—Knowledge is still insufficient for satisfactory classification on this basis. The following is provisional.

a. NORMOCYTIC OR APLASTIC ANÆMIA.—Aplasia of marrow.

- i. PRIMARY.—No known cause. Possibly prolonged absence of unknown factor controlling stage of development in marrow from reticulo-endothelial to megaloblastic cells.

Deficiency Dyshæmopoietic Anæmias—Aplastic Anæmia, *continued*.

ii. ACTIVE DESTRUCTION OF MARROW.—(Direct action on reticulo-endothelial cells.)

a. Exposure to X rays and radio-active substances.

β. Benzol derivatives, e.g., trinitrotoluene.

Note.—Leucocytes, especially myeloid, may be also affected, and reduced (*see* LEUCOPENIA). Anæmia due to acute hæmorrhage is temporarily 'normocytic'—*see* p. 696.

b. MEGALOCYTIC ANÆMIA.—Megaloblastic marrow.

i. INTRINSIC FACTOR DEFICIENT.—

a. *Pernicious Anæmia*.—Factor often completely absent.

1. Pure megalocytic : Reacts to liver alone.

2. Microcytosis also : Needs iron after liver.

β. May also occur partially in : (1) Gastric neoplasm ; (2) Extensive gastric resection ; (3) Atony involving stomach in sprue and intestinal atonies.

ii. EXTRINSIC FACTOR DEFICIENT IN DIET (Nutritional).—Usually partial deficiency. Diet often defective in other substances, e.g., iron, vitamin D.

Nutritional (Megalocytic) Anæmia.—Infants ; tropical ; pregnancy.

Reacts to : (α) Yeast alone ; or (β) Iron after yeast.

iii. HÆMOPOIETIC SUBSTANCE FORMED BUT ABSORPTION DEFICIENT (Alimentary).—Deficiency only partial. Other results of causal diseases present, and microcytic anæmia. Occurs in following conditions :—

a. Sprue.

β. Coeliac disease, steatorrhœa, and fatty diarrhœas.

γ *Dibothriocephalus latus*.

δ. Extensive intestinal defects.

Note.—Intrinsic factor may also fail.

iv. DEFECTIVE STORAGE OF HÆMOPOIETIC SUBSTANCE.—With extensive disease of liver, e.g., cirrhosis. Also metabolic disturbances. May produce achrestic anæmia.

v. VARIOUS SEVERE EXTENSIVE ABDOMINAL DISEASES.—Chronic tuberculosis and other lesions. Affect various factors as above. No treatment effective.

vi. EXHAUSTION OF MARROW.—Megalocytic anæmia may develop thus in conditions usually associated with microcytic anæmia, e.g., acholuric jaundice, hæmolytic jaundice, pregnancy anæmia. Gastric juice may be normal.

Note 1.—Spinal cord is rarely and never extensively affected in conditions other than deficiency of intrinsic factor.

Note 2.—Megaloblasts present usually in all forms. 'Liver' is used to include all preparations of activated substance.

c. MICROCYTIC ANÆMIA.—Normoblastic marrow.

i. EXCESSIVE DEMANDS FOR PRODUCTION OF BLOOD.—Hæmorrhage, hæmolysis and destruction of blood.

ii. NUTRITIONAL DEFICIENCY.—Nutritional (microcytic) anæmia ; infants, tropical, pregnancy. Reacts to iron and general diet.

iii. DEFICIENT ABSORPTION.—

- α. Chlorosis and late chlorosis : mainly iron defect. Reacts to iron alone.
- β. Gastric : simple microcytic (achlorhydric) anæmia. Mainly iron defect. Reacts to iron alone.
- γ. Alimentary disturbances, e.g., diarrhœa. Deficiency of absorption, not only of iron.

iv. GENERAL METABOLIC DISTURBANCES.—Tuberculosis and other wasting conditions.

v. VARIOUS SECONDARY SYMPTOMATIC ANÆMIAS.

d. COMBINED TYPES.—The three types may coexist and overlap in varying degrees. Thus :—

MICROCYTIC ANÆMIA may precede and develop into or be combined with MEGALOCYTIC ANÆMIA by : (i) Additional occurrence of specific megalocytic factors, e.g., loss of intrinsic factor ; or by (ii) Exhaustion of marrow. Price-Jones's curve exhibits excess both of microcytes and megalocytes. The microcytic factor may remain, and this type subsequently reappear clearly when the megalocytic factor has been treated or removed.

MEGALOCYTIC ANÆMIA may pass similarly into APLASTIC ANÆMIA.

Blood Picture.—Various combinations of microcytic, megalocytic, and aplastic changes.

EXHAUSTION OF MARROW may be : (a) Temporary or partial exhaustion—marrow may be hyperplastic but exhausted, or partially aplastic—responsive in varying degrees to rest and blood transfusion, as preliminary to specific treatment ; (b) Permanent true aplasia of marrow—no response to treatment.

CHAPTER CXIX.

SECONDARY AND SYMPTOMATIC ANÆMIA.

I. ANÆMIA DUE TO ACUTE HÆMORRHAGE.

Etiology.—Rapid loss of large amount of blood : exceeding two pints is severe, and exceeding four pints often fatal.

COMMON CAUSES.—Trauma, gastric and duodenal hæmorrhage, post-partum hæmorrhage, tubal pregnancy. Also acute hæmolytic.

Symptoms.—(Due partly to fluid loss.) Shock. Blood-pressure low. Pale, cold, and sweating ; may be restless. Giddiness and faintness, air hunger, thirst ; may be nausea. Pulse small and rapid ; temperature low. Convulsions rarely, with extreme loss (may be intervals of some hours). Blindness rare and transient ; very rarely permanent optic atrophy, only after repeated, never a single hæmorrhage. Œdema occasionally (low blood-protein).

Anæmia due to Acute Hæmorrhage, *continued*.

The Blood.—

1. IMMEDIATELY AFTER HÆMORRHAGE.—Little change; hæmoglobin may rise (capillary stasis).
2. DILUTION OF BLOOD BY TISSUE FLUIDS COMMENCES.—Normocytic anæmia develops, colour index about normal but falling; hæmoglobin continues to fall as dilution proceeds.
3. AFTER ONE TO THREE DAYS.—Bone-marrow responds with hyperplasia and discharges red cells: (a) Red cells low; reticulocytes 5, 10, or up to 25 per cent; microcytes and megalocytes, and few normoblasts and rarely megaloblasts. (b) Hæmoglobin low. (c) Colour index low. (d) Polynuclear leucocytosis; 15,000 to 30,000; lasts a few days. (e) Platelets increased. (f) Coagulability usually increased.

Recovery after single large hæmorrhage in four to five weeks.

Treatment.—(1) Morphia. (2) Fluids by mouth and saline by rectum or subcutaneous injection. (3) Blood transfusion (if given slowly, rise of blood-pressure need not be feared); continuous drip transfusion if hæmorrhage is continuing unchecked; gum saline if blood unobtainable. (4) Measures to check hæmorrhage as indicated. (5) Anæmia: subsequent treatment as in microcytic anæmia; raw liver (but not extracts) has some value.

II. ANÆMIA DUE TO CHRONIC HÆMORRHAGE.

Etiology.—Hæmorrhoids, duodenal ulcer, menorrhagia, and other causes.

Symptoms.—Complaints strikingly slight until hæmoglobin falls to 40 per cent or less. Symptoms elicited on inquiry. Physical and mental weakness and rapid fatigue. The entire system suffers. (1) *Circulatory system*: Shortness of breath, palpitations, faintness, giddiness, and swelling of the feet. (2) *Gastro-intestinal system*: Constipation, dyspepsia, loss of appetite. (3) *Nervous system*: Headache, faintness, and giddiness, *muscæ volitantes* (floating specks in the vision), irritability. In women, amenorrhœa, profuse or irregular menstruation. May be slight pyrexia.

Physical Signs.—(1) *Pallor*, especially of mucous membranes; *sallowness*. (2) *Pulse*: Soft, and easily accelerated. (3) *Heart*: Hæmic murmurs common, either at base or at apex.

The Blood.—Bone-marrow response variable; may be some hyperplasia, but hæmopoietic tissues often exhausted with varying degrees of hypoplasia and sluggish response to treatment. (a) Red cells diminished; reticulocytes low; microcytosis and poikilocytosis; normoblasts absent or scanty. (b) Hæmoglobin low. (c) Colour index low. (d) Leucocytes and platelets often low.

Treatment.—Primary condition to be treated. Anæmia: treat as microcytic anæmia; raw liver (but not extracts) has some value. Blood transfusion may be indicated at onset of treatment.

III. ANÆMIA DUE TO TOXIC AND TOXÆMIC CAUSES.

Symptoms as after chronic hæmorrhage. Exhaustion of marrow common; colour index not greatly below unity. Treatment of cause is first indication, and may be sufficient. Often very resistant to ordinary treatments for anæmia.

CHAPTER CXX.

CHLOROSIS.

A microcytic anæmia commencing at puberty, almost confined to girls, characterized by greenish pallor, symptoms of anæmia, absence of wasting, and rapid improvement on treatment with iron.

Etiology.—

AGE OF ONSET.—Between 14 and 20 years, during or shortly after puberty.

SEX.—Almost confined to girls; in males very rare.

Pathogenesis.—Differs from achlorhydric microcytic anæmia in: (i) Early age incidence; (ii) Menstruation absent or scanty; (iii) Changes in tongue and nails rare; (iv) Presence of hyperchlorhydria. Rapid improvement with iron proves a deficiency factor. Special factor is sexual development with rapid growth at puberty, in unhygienic surroundings. Great frequency in nineteenth century due to unhygienic life at susceptible period. Present rarity shows that development is avoidable. Modern cases are more equal in the two sexes and more resistant to treatment.

Symptoms.—‘Plumpness, puberty, and pallor’. General symptoms and signs of microcytic anæmia.

APPEARANCE.—(1) Complexion pale and waxy. Greenish tinge, whence the name chlorosis: often not obvious. Sclerotics blue and eyes bright. (2) Subcutaneous fat increased.

SPECIAL SYMPTOMS.—*Tiredness, amenorrhæa, constipation.* Swelling of feet. Cold hands and feet. Emotional and nervous. Appetite capricious; flatulence and dyspepsia. Nails and tongue unaffected.

Gastric Secretion.—Free HCl present: may be increased.

The Blood.—Chlorosis is a pure microcytic anæmia: no tendency to progress to megalocytosis or aplasia. *Main change is reduction of hæmoglobin.* (i) Red cells diminished moderately, usually about 4,000,000 per c.mm., infrequently lower unless very severe; microcytosis and poikilocytosis; normoblasts rare; reticulocytes normal. (ii) Hæmoglobin low, often 40 to 50 per cent. (iii) Colour index low, 0.5 or less. (iv) Leucocytes, little change. (v) Volume of blood greatly increased.

Chlorosis, continued.

Course.—Rapid improvement with iron, almost specific, but hygienic surroundings need attention. Recurrences common; but iron maintains its effect, and courses should be given for several years. Tendency to recurrence diminishes in few years, but may persist as anæmia until menopause. Thrombosis is a traditional but rare complication. The blood under treatment follows usual course of a microcytic anæmia with varying reticulocytosis.

Diagnosis.—Usually simple. Note age, sex, appearance, and type of anæmia.

Treatment.—

1. IRON.—As in microcytic anæmia. Specific remedy.
2. DIET.—Mixed balanced diet. Milk and liver of no special value.
3. CONSTIPATION.—Needs aperients.
4. REST.—In bed in severe cases, viz., 3,500,000 red cells or under 50 per cent hæmoglobin. Improvement more rapid and heart protected.

Hygienic surroundings to be considered.

LATE CHLOROSIS.

Resembles simple achlorhydic anæmia (q.v.) in symptomatology and treatment, but free HCl is normal or increased. May be previous chlorosis or anæmia.

CHAPTER CXXI.**SIMPLE ACHLORHYDIC ANÆMIA.**

(*Chronic Microcytic or Hypochromic Anæmia.*)

A chronic microcytic anæmia associated with achlorhydria, occurring almost solely in middle-aged women, and amenable to treatment with iron.

Etiology.—

AGE OF ONSET.—Commonest between 30 and 50 years.

SEX.—Almost confined to women.

ACHLORHYDRIA.—Present in high percentage.

NOTE.—Closely similar anæmia occurs with normal or increased free HCl, and is referred to above as 'late chlorosis.'

HEREDITY.—Microcytic and pernicious anæmia may occur in different members of a family, due to hereditary tendency to achlorhydria.

Pathogenesis.—Development of normal erythrocytes interfered with by deficiency of iron (*see* GENERAL CONSIDERATION OF ANÆMIA, p. 689), due to: (1) Defective absorption owing to achlorhydria;

(2) Deficient diet; and also (3) Loss by menstruation and pregnancy. Similar anæmia may develop after gastrectomy and gastro-enterostomy.

Morbid Anatomy.—*Bone marrow*: moderately hyperplastic; numerous normoblasts, few megaloblasts. *Stomach*: chronic gastritis passing into atrophy of mucous membrane. *Spleen*: simple hyperplasia.

Symptomatology.—

MODE OF ONSET.—Insidious. Patients often never robust. Symptoms traceable for many years. May develop rapidly after pregnancy or an illness.

SYMPTOMS.—Complaints often slight and indefinite, due partly to anæmia and partly to achlorhydria. Tiredness. Shortness of breath. Palpitation. Flatulence, dyspepsia, and constipation. May be pharyngitis and dysphagia. Menorrhagia commoner than amenorrhœa, especially at menopause. Neuroses common.

APPEARANCE.—Usually poor physique. Pale and sallow but not icteroid; often not obviously anæmic. Skin dry. Tongue smooth and red; rarely sore. *Nails brittle*: may be hollow and spoon-shaped (koilonychia): recover on treatment. Glossitis may extend to stomatitis and to pharyngitis (and possibly to Plummer-Vinson syndrome).

SPLEEN.—May be moderately enlarged in chronic severer grades.

Gastro-intestinal System.—

GASTRIC JUICE.—Achlorhydria in high percentage of cases, hypochlorhydria almost invariable. Histamine injection may cause some free HCl in 30 per cent. Achlorhydria persists after treatment; occasional exceptions. Ferments present but reduced.

BARIUM MEAL.—Stomach often empties rapidly from flaccid pylorus. May be rapid passage to cæcum and delay in colon. Atonic features common.

Central Nervous System.—No changes.

The Blood.—

RED CELLS.—(1) Smaller than normal—*microcytosis*; (2) Number often about 4,000,000 per c.mm.; (3) Reticulocytes normal unless count 3,000,000 or under, when increased; under treatment, reticulocyte crisis, rising to 5, 10, or rarely 20 per cent, depending on severity.

SIZE OF RED CELLS.—Average mean diameter 6.8 μ or less (normal 7.2 μ). Price-Jones's curve fairly symmetrical.

HÆMOGLOBIN.—Reduced: may be very low.

COLOUR INDEX.—Low: under 0.7, often 0.4.

LEUCOCYTES.—No definite changes. Platelets normal.

SERUM.—Pale. *Van den Bergh's test* negative.

Course.—Responds to treatment with iron: may be 6 to 8 weeks before change noticeable. Relapses frequent: courses of iron may be necessary throughout life. May improve after menopause, but never robust health.

Simple Achlorhydric Anæmia, *continued*.

Complications and Sequelæ.—Pernicious anæmia may develop, but very rare. Plummer-Vinson's syndrome is believed to be a sequel occasionally. Neoplasms of œsophagus rarely recorded. Thrombosis may occur.

Diagnosis.—From other causes of microcytic and symptomatic anæmia.

Treatment.—

IRON.—Essential (for dosage, etc., *see* TREATMENT OF DEFICIENCY ANÆMIAS). Liver and stomach extracts valueless.

BLOOD TRANSFUSION.—In severe and resistant cases may hasten improvement.

SEPTIC FOCI.—Must be treated. Also other accessory factors.

MENORRHAGIA.—Often serious factor, especially at menopause ; may need specific treatment.

DIET.—Mixed balanced diet.

CHAPTER CXXII.

PERNICIOUS ANÆMIA.

(*Addisonian Anæmia.*)

A severe anæmia, primarily due to an unknown defect in gastro-duodenal secretion, characterized by megalocytosis, achlorhydria, hyperplasia of the bone-marrow, tendency to changes in the spinal cord, and rapid improvement with liver and similar treatment.

Etiology.—

AGE.—Most common 40 to 60 years. Most recorded cases in extreme youth are doubtful.

SEX.—Equally affected.

HEREDITY.—Familial factor not uncommon. Achlorhydria and microcytic anæmia also not infrequent in relatives of subjects.

Nature and Origin.—For general theory, principles of treatment, and relation to other megalocytic anæmias, *see* GENERAL CONSIDERATION OF DYSHÆMOPOIETIC ANÆMIA, and CLASSIFICATION AND TYPES OF ANÆMIA, pp. 686-695.

The intrinsic factor is completely absent and does not return on treatment. Its absence is preceded by achylia, also permanent, and is due to a defect in gastro-duodenal secretion.

FREE IRON.—Presence of 'free iron' and excess of bilirubin in organs, formerly ascribed to hæmolysis, is due to hindrance to their normal consumption in building hæmoglobin. Such iron is available for use in the bone-marrow under liver treatment. Some degree of increased hæmolysis is probable, attributable to destruction of immature and defective red cells by normal processes.

CHANGES IN THE CENTRAL NERVOUS SYSTEM.—Probably due to some closely allied but not necessarily identical defect. (*See* SUBACUTE COMBINED DEGENERATION OF THE CORD.)

Other Megalocytic Anæmias.—Relation to these is discussed on pp. 689 seq.; *see also* CLASSIFICATION AND TYPES OF ANÆMIA, p. 691.

IN OTHER MEGALOCYTIC ANÆMIAS:—

1. Causal disease often evident: cure of anæmia still leaves these symptoms.
 2. Anæmia is only occasionally megalocytic. Microcytic anæmia is commoner and also may precede or follow a megalocytic phase.
 3. Leucocytic changes not uncommonly present which differ from pernicious anæmia, especially leucocytosis.
- Blood changes consequently are rarely typical of pernicious anæmia.

PRINCIPAL DIFFERENCES.—

	<i>Pernicious Anæmia.</i>	<i>Other Types.</i>
1. Leucocytes ..	Leucopenia	Leucocytosis usual
2. Neutrophils	Lobes increased	Lobes not increased
3. Poikilocytosis	Marked	Slight
4. Free HCl ..	Absent	May be present
5. Indirect van den Bergh	High: 2 to 5 units	Low: 0.2 to 0.5
6. Yeast ..	No effect	Often active
7. Blood sugar	Normal	Often flat curve

With careful study of blood and clinical state, errors of diagnosis are rare. Any unusual symptom or blood feature, especially leucocytosis, must be carefully considered.

Morbid Anatomy.—

CARDINAL CHANGES.—(1) Atrophic gastritis; (2) Megaloblastic hyperplasia of bone-marrow; (3) Free iron in various organs; (4) Fatty degeneration; (5) Changes in spinal cord.

GENERAL.—Wasting slight or absent. Pallor or yellow tint. Fat yellow. Muscles bright red. Petechial hæmorrhages on serous surfaces. May be serous effusions.

STOMACH.—Diffuse atrophic gastritis.

BONE-MARROW.—Megaloblastic hyperplasia. Typically exhibited by femur:—

MACROSCOPIC.—Marrow deep red and gelatinous: commences in patches, but often no yellow marrow; may be areas of aplasia, absorption of bone, and expansion of marrow cavity.

HISTOLOGY.—Great increase of megaloblasts, giantoblasts, and primitive generations of both *red and white cells*.

HEART.—Fatty degeneration extreme, especially on and near papillary muscles (yellow spots on red muscles).

LIVER.—Normal size or somewhat large; yellow and fatty; *free iron in excess*, especially in outer zone of lobules.

SPLEEN.—Usually enlarged; considerable fibrosis; *free iron in excess*. Occasionally atrophied.

HISTOLOGY.—Cells few in number, mainly lymphocytes and phagocytes containing red cells.

SPINAL CORD.—Subacute combined degeneration common.

Pernicious Anæmia, continued.**Symptoms.—**

GENERAL CHARACTERISTICS.—(1) *Onset insidious*; (2) *Complaint of great weakness*; (3) *Pallor marked*, often yellowish; (4) *Wasting slight or absent*. Condition usually fully developed on first observation. Previous health usually good, but occasionally record of anæmia. May be pyrexia.

Symptoms are referable to the affected systems.

ANÆMIC SYMPTOMS.—(1) *Weakness*. (2) *Dyspnœa*, palpitation, faintness, swelling of ankles. *Amenorrhœa* common.

GASTRO-INTESTINAL SYMPTOMS.—Associated with achylia and atrophic gastritis. (1) *Sore tongue*: in about 50 per cent; may precede anæmia by period of years, and then pass. In early stages may be red and fissured, or may appear normal, though sore; in later stages smooth and atrophic. (Extension to pharynx and Plummer-Vinson's syndrome very rare.) (2) *Dyspepsia* and *flatulence*. Attacks of vomiting. *Diarrhœa* or soft motions.

NERVOUS SYMPTOMS.—*Paræsthesia* of extremities (*acroparæsthesia*), e.g., tingling and numbness early and common (possibly anæmic and pass on treatment). Mental symptoms occasionally, usually delusions of persecution.) (*See also SUBACUTE COMBINED DEGENERATION OF THE CORD.*)

FACIES AND PHYSICAL CHANGES.—Extreme anæmia: skin of yellowish tint due to increased bilirubin in blood (less common nowadays with earlier diagnosis). Hair often prematurely grey. May be areas of leucoderma and pigmentation. No wasting. Nails: no special change. Teeth frequently but not invariably septic.

SPLEEN.—Moderate enlargement in severe cases (nowadays rarely palpable).

CARDIO-VASCULAR SYSTEM.—Blood-pressure low. Pulse rapid. Heart: hæmic murmurs and dilatation common.

URINE.—Urobilin increased. Trace of albumin common.

FÆCES.—Urobilinogen increased.

HÆMORRHAGES.—Rare, occasionally in retina. Purpura, internal and external hæmorrhages very rare.

PAIN IN LONG BONES.—Traditional symptom. May be acroparæsthesia, absorption of bone, or subacute combined degeneration. Now rarely diagnosed.

Gastric Secretion.—Achylia invariable (over 99 per cent): total juice very small. Achlorhydria complete and permanent. No response to histamine injections or cure of anæmia. Achlorhydria precedes anæmia. Intrinsic factor always absent.

The Blood (Untreated).—*Megalocytosis* is essential feature: due to shift back in marrow to more primitive megaloblastic stage. All formed elements are diminished.

1. QUALITATIVE CHANGES IN RED CELLS.—

a. Size.—Mean size and volume always increased. Mean diameter: about 8.3. Price-Jones' curve: shifted to

right, flattened with broad base. Cells of full colour, often oval. Microcytes also present.

b. ANISOCYTOSIS AND POIKILOCYTOSIS.—Marked. Nuclear remnants in some cells (Howell-Jolly bodies and Cabot's rings).

c. NUCLEATED RED CELLS.—Rarely present in mild cases. The characteristic megaloblast usually present if red cells below 2,500,000 per c.mm., but often scanty. Occasionally large forms ('gigantoblasts'). All nucleated red cells may be numerous in terminal or serious stages, so-called 'blood crisis' (also may occur at onset of treatment without bad prognosis).

d. RETICULOCYTES.—About 2 per cent: occasionally 4 to 5 per cent.

e. POLYCHROMASIA.—Cytoplasm stains blue.

2. QUANTITATIVE CHANGES IN RED CELLS.—

NUMBER OF RED CELLS.—Great reduction: often 1,000,000 to 2,000,000 per c.mm. or lower.

HÆMOGLOBIN.—Much reduced, but not to same percentage as number of cells, as the large red cells are fully hæmoglobinized.

COLOUR INDEX.—High: usually 1.1 to 1.2; may be 1.8 if red cells very low.

3. LEUCOCYTES.—*Leucopenia*: usually 2000 to 4000 per c.mm. Relative lymphocytosis, 50 per cent. Neutrophils: *increased lobulation*, 4 or 5 lobes common, viz., shift to right on Arneth's count: occasionally large sizes. Eosinophils and basophils reduced. Myelocytes occasionally present, but scanty. *Leucopenia* is due partly to megaloblastic proliferation affecting myeloid tissue in marrow.

Türk's stimulation cells are often found.

4. BLOOD-PLATELETS.—Number very scanty.

5. SERUM.—Separates rapidly: has yellowish tint. *Van den Bergh reaction*: indirect positive, high, 2 to 5 units. *Icteric index*: raised, 8 to 12.

Cholesterol low. Coagulation time increased. Blood-sugar normal.

Progress and Remissions without Specific Treatment.—

REMISSIONS.—Great improvement or 'recovery' usually occurs in first attack. Such 'remissions' are a distinct feature. Rarely exceed three. Interval before second attack often six to twelve months; subsequent remissions shorter and less complete.

BLOOD CONDITION DURING REMISSION.—In first remission, anæmia generally improves rapidly, but rarely reaches normal; changes resemble those under treatment but less complete. The colour index especially tends to remain high.

ULTIMATE PROGNOSIS.—Fatal. Duration one to three years, rarely longer, from first observation. Acute course—a few weeks—may occur; or steady descent; others remain stationary several months, then commence to fail. From observations during remissions, disease has probably lasted six to twelve months before initial complaint.

Pernicious Anæmia, continued.

The Blood (under Efficient Specific Treatment).—All abnormalities tend to return towards normal.

RETICULOCYTES.—Earliest evidence of reaction to treatment. Under oral treatment rise commences in 4 to 5 days; maximum in 10 to 14 days; returns to normal in 20 days. With intramuscular injections figures are 3, 5, and 14 days, and for intravenous injections 2, 4, and 10 days. *Amount of rise:* increases with severity of anæmia: little or no rise if red cells initially over 3,000,000; rise reaches 35 per cent with initial count of 1,500,000. (Rise may be absent if preliminary blood transfusion.)

RED CELLS.—Rise commences few days after reticulocytes: about 500,000 weekly. Size and shape return towards normal. *Note:* Treatment must be pressed until red cells number 5,000,000.

HÆMOGLOBIN.—Rises more slowly: about 1 per cent daily. Colour index may fall below unity (indicating need for iron medication).

LEUCOCYTES.—Return slowly towards normal. Eosinophilia may be transient; 20 per cent under raw liver. *Platelets* increase.

BLOOD CRISIS.—May occur temporarily at onset of intensive treatment in severe cases: cells mainly normoblasts.

Progress and Prognosis under Specific Treatment.—Essential cause permanent. Blood can be brought to and maintained at normal; general condition improves rapidly, but tachycardia, etc., more slowly; often sensation of perfect health with red cells at 3,000,000 and hæmoglobin at 60 per cent, but red cells must be brought to and kept above 5,000,000. *Spinal lesions* advance if red cells under 5,000,000, but arrested if kept above; no proof that lesions can resolve, but marked clinical improvement from relief of anæmia and re-education.

Theoretically, life should continue to normal length; in practice, at present averages $3\frac{1}{2}$ years under treatment; mortality partly due to advance of spinal lesions with insufficient treatment, partly to sepsis and complications interfering with action of specific treatment. Increased use of injections of extracts, larger dosage, and improved maintenance will probably lengthen life.

Return of HCl and intrinsic factor with permanent cure is excessively rare and not fully substantiated in true pernicious anæmia.

Complications.—

SUBACUTE COMBINED DEGENERATION OF SPINAL CORD (q.v.).

Note.—Complications as follows interfere with effect of specific treatment: dose needs great increase, but may still fail and gradual or rapid fatality result.

SEPSIS.—Frequent. Boils and abscesses: polynucleosis may or may not result. Pyelitis. Cholecystitis (suspect if dyspepsia persists).

CHRONIC NEPHRITIS. DIABETES.—Association not rare.
CARCINOMA OF STOMACH.—May develop: relation at present uncertain.

PNEUMONIA.—High mortality.
Tuberculosis is rare.

Diagnosis.—The characteristic symptoms and blood changes form generally an easy diagnosis: middle-aged patient; complains of weakness; onset insidious; extreme anæmia; wasting slight; blood shows megalocytosis and great diminution of red cells, high colour index, leucopenia, and megaloblasts.

If a megalocytic anæmia does not improve under specific therapy, either it is not pernicious anæmia or complications are present.

SPECIFIC METHODS.—(1) Blood examination; (2) Gastric juice; (3) Sternal puncture.

DIAGNOSIS FROM:—

1. OTHER MEGALOCYTIC ANÆMIAS.—*See* p. 694. Note sprue, steatorrhœa, achrestic anæmia.
2. MICROCYTIC ANÆMIA.—By blood examination.
3. CARCINOMA OF STOMACH.—(a) Anæmia is usually microcytic; (b) Wasting; (c) Radiographs; (d) Gastric total acidity and ferments usually not reduced so completely as in pernicious anæmia. May coexist. Anæmia may be megaloblastic and partly respond to treatment.
4. APLASTIC ANÆMIA.—Megalocytosis less. Van den Bergh reaction negative. Pernicious does not develop into true aplastic anæmia, but mixed forms occur (*see* p. 709). Specific therapy useless.
5. ADDISON'S DISEASE.—Facies and symptoms and pigmentation occasionally close resemblance.
6. BLOOD DISEASES.—E.g., chronic hæmolytic anæmia, Lederer's anæmia, atypical leukæmia: may be difficult. Nephritis, myxædema, occasionally cause mistakes.

Treatment.—'Substitution therapy' with liver (or hog stomach) is essential treatment (*see* p. 707). *Treatment must continue for life.* Dosage sufficient to keep blood permanently at 5,000,000 red cells and 100 per cent hæmoglobin (to prevent spinal lesions). Blood-count observed at intervals. *Maintenance:* best and cheapest method is intramuscular injection, 4 c.c. every 3 weeks. Increased dosage indicated in:—

1. Subacute combined degeneration. Large dosage indicated when symptoms present. If marked, intensive therapy—e.g., daily intramuscular injections for several weeks, also with iron.
2. Infections and complications.
3. Old age. Arteriosclerosis.

For other measures *see* TREATMENT OF DEFICIENCY ANÆMIAS, p. 706.

ACHRESTIC ANÆMIA.

A megalocytic anæmia due to failure either to store or to mobilize and utilize store of hæmopoietic substance from liver and organs (Wilkinson and Israëls). No achlorhydria or error of absorption. Symptoms and blood changes as in pernicious or aplastic anæmia. Bone-marrow hyperplastic or normal. Occurs at all ages after childhood. Duration many years. Rare.

Treatment.—Ordinary measures unavailing. Some cases react to continued intensive treatment—e.g., regular intravenous injection of liver extract. Blood transfusion often indicated, but results may be slight.

CHAPTER CXXIII.**TREATMENT OF DEFICIENCY ANÆMIAS.**

Essential preliminary to treatment: (1) Correct diagnosis; (2) Blood-count, repeated as necessary to watch progress. *Note:* Transient reticulocytosis occurs in all anæmias responding to treatment. Special indications are referred to under the various diseases.

GENERAL MEASURES.—

1. **REST.**—In bed in severe anæmia. Improvement more rapid and heart protected.
2. **INITIAL CAUSES, SEPTIC FOCI, COMPLICATIONS.**—(These inhibit all forms of treatment for anæmia.) Appropriate treatment.
3. **DIET.**—Red meat. Green vegetables. Fruit.

Microcytic Anæmia.—Progress estimated by red cells and hæmoglobin.

IRON.—Specific treatment. Preparations in order of efficiency:—

1. **FERROUS SALTS.**—Blaud's pill (ferrous carbonate): daily dose, gr. 40 to 60; must be fresh and soft. Ferrous chloride and sulphate: daily dose, gr. 10.
2. **SCALE PREPARATIONS.**—E.g., ferri et ammon. cit.: daily dose, gr. 60 to 120. In simple mixture.
The above preparations are sufficient for all purposes.
3. **REDUCED AND COLLOIDAL IRON.**—Insoluble and poorly absorbed.
4. **FERRIC SALTS.**—Efficient, but gastric irritant.
5. **INJECTIONS.**—Most preparations entirely valueless. Larger doses are painful: iron poisoning has followed (headache and vomiting; paralysis).
6. **ORGANIC PREPARATIONS,** e.g., hæmoglobin, are valueless.

COPPER.—Probably essential (and also manganese) for hæmoglobin. Sufficient in iron and in diet: may be given in nutritional anæmia of infancy.

LIVER. HOG'S STOMACH.—Unnecessary: maximum response obtainable without it: usually valueless. Whole liver assists in anæmia due to hæmorrhage.

BLOOD TRANSFUSION.—In severe and resistant cases hastens improvement.

HYDROCHLORIC ACID.—Improves dyspepsia: no influence on anæmia. Dose: \mathfrak{M} 30., t.d.s.

Arsenic.—Contra-indicated. Tends to depress bone-marrow.

Megalocytic Anæmia.—Progress estimated initially by reticulocytosis, later by red cells and hæmoglobin, finally by disappearance of megalocytosis. 'Substitution therapy' is administration of substances containing the hæmopoietic substance ('P.A. factor').

LIVER (CALF).—Contains store of hæmopoietic substances. Principle is probably a polypeptide, is heat-stable, and active extracts can be prepared. Various fractions have been separated, some inactive. Extracts, preferably injections, should always be used for maintenance.

INCREASED DOSAGE.—Indicated in: (1) Old age and arteriosclerosis; (2) Infections and complications.

WHOLE LIVER.—Raw or cooked. Initial dose: half to one pound daily. Maintenance: $1\frac{1}{2}$ to 2 lb. weekly. Advantage: always potent, contains also iron and vitamins. But cannot be taken adequately for long periods, and must not be so prescribed.

EXTRACTS BY MOUTH.—(If injections contra-indicated.) Dosage equivalent to whole liver.

INTRAMUSCULAR INJECTION OF EXTRACTS.—Initial dose (pernicious anæmia): 2 to 5 c.c. every 3 days; interval gradually lengthened. Maintenance: 4 to 6 c.c. every 3 weeks. May cause pain on injection (change preparation).

INTRAVENOUS INJECTION OF EXTRACTS.—At onset in severe and resistant cases. Dose: 5 c.c. May be fall in blood-pressure; also urticaria, collapse.

DESICCATED HOG'S STOMACH.—Efficient. Initial dose: daily 10 gm. for each million reds deficient. Maintenance dose: one-third of initial dose. Insoluble in water, heat-labile. *Is not same as principle in liver.* No extracts. Many preparations impotent.

YEAST.—*Marmite* (autolysed yeast product): effective in tropical megalocytic anæmia; less so in sprue; in pernicious anæmia usually fails, unreliable, should not be employed. *Marmite* factor is heat-stable: probably mainly extrinsic, with a little intrinsic factor; nature unknown; is not vitamin B_1 , B_2 , or B_4 .

IRON.—Indicated only: (1) If microcytic stage develops, i.e., if colour index falls below unity under treatment; (2) In certain nutritional anæmias. Otherwise valueless and may irritate stomach.

Treatment of Megalocytic Anæmia, *continued*.

BLOOD TRANSFUSION.—In patients too ill to react. Indicated (and repeated) in megalocytic anæmia of pregnancy. Rarely needed in pernicious anæmia with present preparations.

RESISTANT CASES.—May be due to: (1) Insufficient dosage; (2) Complications; (3) Exhaustion of marrow or aplasia. Various other factors exist. *Persistent reticulocytosis*: may continue without improvement of anæmia with hæmolysis or complications.

For hydrochloric acid and arsenic, *see* MICROCYTIC ANÆMIA.

Combined Megalocytic and Microcytic Anæmias.—Treatment for both forms necessary.

CHAPTER CXXIV.

APLASTIC ANÆMIA.

A fatal condition due to aplasia of the bone-marrow, characterized by extreme anæmia, leucopenia, thrombocytopenia, and absence of abnormal or nucleated red cells.

Is not an entity. Final clinical manifestations and blood changes are due to the aplasia.

Aplasia may affect precursors of red and white cells and platelets simultaneously (aplastic anæmia); or precursors of white cells only (agranulocytosis); rarely, of red cells only.

(*See* GENERAL CONSIDERATION OF DYSHÆMOPOIETIC ANÆMIA and CLASSIFICATION AND TYPES OF ANÆMIA, pp. 686-695.)

Causes.—(1) *Primary*: no obvious cause. (2) *Secondary*, exposure to: (a) X rays, radium, and radio-active substances; (b) benzol derivatives—e.g., trinitrotoluene, arsenobenzol; (c) heavy metals, mercury, gold. (3) Exhaustion of marrow: partial aplasia, e.g., formerly occurred in pernicious anæmia. Infections, e.g., diphtheria, may be rare cause.

Etiology.—*Age*: usually young adults. *Sexes* equal.

Morbid Anatomy.—*Bone-marrow* of femur: Yellow marrow alone present, little or no red marrow left (except microscopic foci). Changes less complete in ribs and vertebræ. In liver and spleen, free iron usually absent, and when present, amount small.

Symptoms.—

ONSET.—With pallor and symptoms of severe anæmia. No icteroid tinge. Insidious. No specific physical changes.

HÆMORRHAGES.—Purpura. Mucous membranes. May occur at any site.

BLOOD CHANGES.—Quantitatively severe: qualitatively slight.

1. **LEUCOCYTES.**—Extreme leucopenia (800 to 2000), with relative lymphocytosis (may be 90 per cent).

2. **NUMBER OF RED CELLS.**—Very low, 500,000 to 1,500,000 per c.mm.

3. APPEARANCE OF RED CELLS.—Normal: *no nucleated cells*, poikilocytosis, etc., present. Reticulocytes low, 1 per cent: rarely 5 per cent.
4. SIZE OF RED CELLS.—Within normal limits.
5. COLOUR INDEX.—Variable, above unity or low.
6. BLOOD-PLATELETS.—Very scanty or absent.
7. SERUM.—Pale. Van den Bergh negative.
8. COAGULATION TIME.—Increased.
9. BLEEDING TIME.—Increased.

ACHLORHYDRIA.—Nearly always, but not invariably, present.

Progress.—Usually rapid towards end. Anæmia and hæmorrhages increase. Stomatitis common. No definite remissions. No spinal-cord changes.

Duration.—Rarely exceeds six months from recognition.

Treatment.—Remove cause if possible. *Blood transfusion*: repeat frequently: but severe reactions, hæmolysis, collapse common. Occasional recovery in secondary cases. Liver useless. Consider splenectomy.

Variations.—Intermediate forms between aplastic and pernicious anæmia occasionally recorded: may be some qualitative changes in blood and diagnosis difficult. At autopsy some bones may show hyperplasia and some aplasia; occasionally both changes in same bone, with sharply defined line of demarcation.

TRINITROTOLUENE (T.N.T.) POISONING.

Symptoms.—Cyanosis is common among workers, even in absence of anæmia: nitroxy- and methæmoglobin in blood. Fatal cases are due to:—

1. TOXIC JAUNDICE.—Jaundice. Hæmorrhages common. Aplastic anæmia never present at onset. Milder forms of jaundice recover. *Morbid anatomy*: acute yellow atrophy of liver.
2. APLASTIC ANÆMIA.—Rarer than above. Not necessarily preceded or accompanied by toxic or simple jaundice.

A long interval may occur between exposure to T.N.T. and onset of toxic jaundice, and even longer (many months) in case of aplastic anæmia.

CHAPTER CXXV.

HÆMOLYTIC ANÆMIAS.

Hæmolysis formerly believed to be explanation of certain anæmias for which other causes are now known, e.g., pernicious anæmia. Is not considered to be common sole cause of anæmia: thus, toxins causing hæmolysis probably also affect bone-marrow and diminish formation. Free iron in tissues and even jaundice may be also sequelæ of reduced formation.

Hæmolytic Anæmias, continued.**Characteristics of Hæmolytic Anæmia.—**

1. **JAUNDICE.**—If hæmolysis acute and severe. Icteric index raised. Van den Bergh's reaction : positive indirect or diphasic. Increased urobilin and faecal blood pigments in milder forms but not jaundice.
2. **HÆMOGLOBINURIA.**—If acute.
3. **BLOOD CHANGES.**—(a) *Anæmia* : microcytic, less often megalocytic. Nucleated red cells present. (b) *Reticulocytes* : high, 20 to 50 per cent. (c) *Fragility* : usually increased. (d) *Leucocytes* : usually rise in acute forms ; may be immature cells. (e) *Blood-platelets* : variable.
4. **CHANGES IN ORGANS.**—*Spleen* and usually liver enlarged : rarely glands. Free iron in liver and spleen. No other constant changes.

Classification.—Due to :—

1. **INFECTIONS.**—Septicæmia, gas gangrene, malaria, yellow fever, oroya fever.
2. **POISONS.**—Phenylhydrazine, dinitrobenzene, toluene diamine and allied drugs, quinine, chlorates, lead and arsenic compounds, phosphorus ; ricin, saponin ; snake venom ; severe burns ; fabism ; incompatible blood transfusion.
3. **CONGENITAL ABNORMALITIES OF THE RED CELLS.**—(a) Acholuric jaundice ; (b) Sick-cell anæmia (see p. 714) ; (c) Hæmolytic anæmias of the newborn (see p. 747).
4. **UNKNOWN ORIGIN.**—(a) Acute hæmolytic anæmia of Lederer (see p. 713) ; (b) Paroxysmal hæmoglobinuria—(i) cold (syphilitic), (ii) exercise, (iii) nocturnal, (iv) myoglobinuria.

ACHOLURIC JAUNDICE.

(*Hæmolytic Jaundice. Hæmolytic Anæmia.*
Acholuric Family Jaundice.)

A chronic condition characterized clinically by anæmia, jaundice, and splenomegaly with recurrent acute crises, and pathologically by spherical red cells, increased fragility of red cells, reticulocytosis, and absence of bile from the urine.

Groups.—(1) *Hereditary, familial, congenital* (Chauffard-Minkowski type) : exhibited and transmitted by either sex : acts as dominant Mendelian character : commonest form. (2) *Acquired* (Hayem-Widal type) : onset in adult life.

Note.—Under dispute whether or not the two types have the same origin.

Hereditary and Familial Type.—

PATHOGENESIS.—Essential feature is a number of spherical red cells ; diameter small, about 6.5μ , but volume normal ; these are rapidly destroyed by spleen, resulting in anæmia, jaundice, and splenomegaly ; fragility of these cells only is increased.

'Fragility' not essential defect: may be normal in familial cases. Bilirubin in blood is increased but is linked with protein and hence not excreted by kidney: also renal threshold for bilirubin rises. Splenectomy protects the defective cells.

CHARACTERISTICS.—

1. GENERAL SYMPTOMS.—'More icteric than sick'. Fair health over long periods. *Crises*: recurrent, may be 3 or 4 a year; pyrexia, prostration, may be vomiting and abdominal pain; anæmia, jaundice, spleen increase rapidly; last a few weeks.
2. SPLEEN.—Enlarged, to umbilicus: adhesions unusual, engorged with red cells. LIVER palpable. Free iron present. BONE-MARROW: hyperplastic.
3. JAUNDICE.—Varies, often slight during intermissions. No icteric symptoms. Van den Bergh's reaction: indirect positive or diphasic
4. RED CELLS.—(a) *Anæmia*: about 3,500,000. (b) *Colour index*: high usually. (c) *Spherical cells*: appear as dark small cells, but volume is normal. Anisocytosis marked. Few nucleated cells. (d) *Reticulocytes*: often 10 to 15 or up to 30 per cent: in intermissions may be 3 to 5 per cent: in crises 20 to 50 per cent. (e) *Fragility*: increased; hæmolysis commences about 0.65 per cent sodium chloride and extends over long range. *Leucocytes*: no special change, but rise in crises.
5. URINE.—Bile pigment absent. Urobilin, 10 to 30 times normal. FÆCES: bile pigments increased.
6. GALL-STONES.—Present in 60 per cent: pigment and bilirubin, no cholesterol. Soft.

COURSE.—Consistent with fair health and activity throughout life. *Crises* are main anxiety: blood may be megalocytic: Lederer's anæmia, leukæmia, and pernicious anæmia may be suggested.

TREATMENT.—

SPLENECTOMY.—Mortality about 5 per cent: results very good; unnecessary in mild grades. If gall-stones present, should be crushed or removed; not cholecystectomy. Spherical cells and fragility not permanently altered.

BLOOD TRANSFUSION.—With severe anæmia and before operation. Severe but not dangerous reactions may occur.

ANÆMIA.—Iron. Liver of doubtful value: does not affect reticulocytosis. Irradiation of spleen useless.

Acquired Type.—

VARIATIONS FROM FAMILIAL TYPE.—'More sick than icteric'. Jaundice less. Anæmia more severe, often megalocytic. Spherical cells and fragility less marked. Auto-agglutinins often present, also hæmolysins. 'Crises' dangerous.

Note.—May be sporadic cases of the familial type: uncertain. Atypical forms not uncommon.

TREATMENT: *Splenectomy* less successful, but results fair. *Blood transfusion*: severe reactions not uncommon.

Acholic Jaundice, continued.

Atypical Forms.—Include: (1) Fragility normal; (2) Icterus absent; (3) No splenomegaly. Atypical blood changes, especially in acquired type, may suggest pernicious anæmia, erythræmia, Lederer's anæmia, leukæmia, leuco-erythroblastosis; free hæmoglobin may be present in blood, as may occur in nocturnal hæmoglobinuria. Syphilis must be excluded.

HÆMOGLOBINURIA.

The presence in urine of free hæmoglobin without the corresponding presence of red cells.

Etiology.—May occur in any severe grade of hæmolytic anæmia. Is due to pre-renal hæmolysis, and associated with anæmia and methæmoglobinæmia. Pigment from hæmolysis is normally converted into bile in the liver; when amount moderate, this conversion is complete and none escapes into the urine as in ordinary form of acholic jaundice; when amount excessive some escapes into urine, probably about 5 to 10 per cent of free hæmoglobin. Methæmoglobin and hæmoglobin both present.

Character of Urine.—

COLOUR.—Almost black, brown, claret, or pale red.

ALBUMIN.—Present, and may persist several days after disappearance of blood pigment.

SEDIMENT.—Profuse and dark. Characterized by absence of sufficient red cells to account for pigment. Contains débris of scanty red cells; urates.

SPECTROSCOPE.—Methæmoglobin band between C and D, removed by Am_2S ; also hæmoglobin bands. (Urine usually needs considerable dilution.)

Diagnosis.—Characteristic is presence of pigment in absence of sufficient red cells to account for the amount.

PAROXYSMAL HÆMOGLOBINURIA.

Paroxysmal attacks of hæmoglobinuria may be:—

1. **From Cold** (syphilitic paroxysmal hæmoglobinuria).—

ETIOLOGY. In adults. Syphilitic lesions in 30 per cent, and Wassermann reaction positive in 90 per cent. Raynaud's syndrome may coexist.

PATHOGENESIS.—Serum contains a hæmolysin; this is set free by cold; unites with red cells in cold; hæmolysis takes place on warming (Donath-Landsteiner reaction).

SYMPTOMS.—Sudden onset: malaise, shivering, headache, severe pains in muscles, vomiting; coldness and cyanosis as in Raynaud's disease. May be pyrexia, and urticaria. Liver and spleen may be palpable. Duration: few hours. Hæmoglobinuria after attack: may be slight jaundice. *Blood*: severe anæmia followed by regeneration, reticulocytes numerous, and nucleated red cells.

TREATMENT.—Prophylaxis against cold. Anti-syphilitic treatment. Alkalis (hinders precipitation of pigment in renal tubules, whence anuria).

2. From Exercise.—In young males: severe exertion, especially in position of lordosis. Cold and syphilis are not factors. No hæmolysin in blood (Donáth-Landsteiner reaction negative). No constitutional symptoms. No ill-effects. Injections of serum may be preventive. *Note:* In this type hæmolysis possibly is localized in renal vessels.

3. Nocturnal Hæmoglobinuria (Marchiafa-Micheli's disease).—Very rare. Cold, exercise, and syphilis are not factors. No hæmolysin in blood (Donáth-Landsteiner reaction negative). Characterized by recurrent attacks of hæmoglobinuria (or hæmosiderinuria), mainly nocturnal, with malaise, pyrexia, and pains. *Blood:* severe anæmia with leucopenia, reticulocytes numerous. Long intervals of freedom. Health deteriorates; liver and spleen enlarge; jaundice chronic. *Prognosis bad;* death from anæmia in 3 years or more.

TREATMENT.—Liver no effect. Splenectomy contra-indicated. Blood transfusion may precipitate paroxysm.

4. Paralytic Hæmoglobinuria (Myoglobinuria).—Very rare. Characterized by muscular pains progressing to paralysis, with myohæmoglobin (colouring matter of muscle) in blood and urine. At autopsy, muscles white, 'fish-flesh'. Possibly due to chemical poisons. (Occurs in well-fed horses who have been rested and then worked again.)

CHAPTER CXXVI.

ACUTE HÆMOLYTIC ANÆMIA OF LEDERER.

(*Acute Febrile Anæmia.*)

An acute hæmolytic anæmia of unknown origin accompanied by leucocytosis developing with great rapidity and often responding successfully to blood transfusion. Rare.

Etiology.—Occurs in both sexes and all ages: commonest under 20 years. Occurs in pregnancy.

Pathogenesis.—Unknown. No constant factors. Marrow may be hyperplastic; thrombi in vessels throughout body.

Symptoms.—Onset acute. Fever, rigor, malaise; may be vomiting and diarrhoea. Anæmia and pallor develop rapidly. Jaundice usual but not severe and may be absent. Exhaustion and coma develop in absence of treatment. Hæmoglobinuria occasionally. Liver and spleen may slightly enlarge. Various symptoms due to thrombosis.

Acute Hæmolytic Anæmia of Lederer, *continued*.

Blood Changes.—

RED CELLS AND HÆMOGLOBIN.—Fall rapidly. No constant size for red cells. Reticulocytes may be 10 to 15 per cent.

COLOUR INDEX.—High or reduced.

NUCLEATED RED CELLS.—Normoblasts and megaloblasts present, either in great numbers or scanty.

LEUCOCYTES.—Number increased: rarely may be 100,000 per c.mm. or more. Myelocytes may be numerous.

VAN DEN BERGH REACTION.—Indirect positive.

FRAGILITY.—May be temporarily increased.

Diagnosis.—Often regarded as undiscovered infection, or pernicious anæmia with spontaneous recovery, or leukæmia with recovery.

Treatment.—Blood transfusion essential: repeated if necessary (may be reactions). Liver and iron valueless in acute stages.

Course and Prognosis.—With blood transfusion, recovery may be rapid and complete. Otherwise high mortality, or recovery in two to six weeks. May be recurrences or good health for many years.

Variations.—Cases occur with rapidly developing 'acute febrile anæmia' without evidence of hæmolysis.

CHAPTER CXXVII.

SICKLE-CELL ANÆMIA.

(*Drepanocytosis*.)

An hereditary condition characterized by an abnormality of the red cells with resulting anæmia.

Chief Characters.—

1. Confined to negroes. Both sexes affected. Hereditary and familial.
2. Fresh blood, after standing 6 to 24 hours, contains many sickle-shaped red cells, may be 25 to 100 per cent: not numerous when first drawn.
3. Blood: Red cells and hæmoglobin reduced. Colour index about unity. Few normoblasts. May be leucocytosis. Fragility about normal. Blood-platelets not reduced. Coagulation time normal. Bile in serum.
4. Symptoms: Latent, or anæmia. May be severer exacerbations. No hæmorrhages. Tendency to ulcers on legs. Liver slightly enlarged. Spleen not palpable. Glands variable.
5. Progress: Severer cases die early of anæmia and intercurrent disease: bone-marrow hyperplastic. Value of splenectomy doubtful.

CHAPTER CXXVIII.

ANÆMIAS OF PREGNANCY.

Anæmia occurs in pregnancy in many forms. It may be slight or of great severity. In onset insidious or sudden, before or after labour. In type microcytic or megalocytic (pernicious anæmia of pregnancy), or mixed. Most types, even severe, respond well to treatment, and more attention should be given to the blood in pregnancy.

Physiological Anæmia.—Blood volume increases by dilution in later months and hæmoglobin percentage falls to about 75, though amount in body increases.

Causes of Anæmia.—

1. Demands of fœtus, especially for iron.
2. Capricious appetite.
3. Changes in gastric secretion : free HCl falls (and possibly intrinsic factor).
4. Pre-existing anæmia.
5. Deficient diet.

Effect on Fœtus.—In milder microcytic anæmia, fœtus not anæmic at birth. In severe forms, may be miscarriage or premature birth.

I. TROPICAL ANÆMIAS OF PREGNANCY.

Occur frequently in India. Due to nutritional defects.

Important Characteristics.—

1. May be : (a) Microcytic—ordinary features of secondary anæmia ; or (b) Megalocytic, 'pernicious anæmia of pregnancy'.
2. Microcytic type can develop into megalocytic type.
3. Free HCl may be present or absent in either type.
4. Similar anæmias occur in men, or in non-pregnant women, but the megalocytic form is very rare.

II. GENERAL ANÆMIAS OF PREGNANCY.

In temperate zones, the same types of microcytic and megalocytic anæmias occur : no gross difference separates them from the tropical forms.

Microcytic and Megalocytic Types.—Both types have following common characteristics :—

1. No relation to age.
2. Commoner in, but not confined to, primiparæ ; may occur in successive pregnancies, usually with increasing severity if untreated, but proper prophylactic treatment is effective.
3. Symptoms usually appear late in pregnancy, but may not appear until confinement or subsequently.
4. No definite relation to (a) syphilis, (b) toxæmia of pregnancy, (c) hæmorrhage at confinement, (d) achlorhydria, (e) sepsis : but these factors, if present, tend to aggravate condition and *inhibit success of treatment.*

General Anæmias of Pregnancy, *continued*.

Microcytic Anæmia.—

SYMPTOMS.—As in secondary anæmias. Occasionally develop after confinement, and then often slow response to treatment.

TREATMENT.—Rest in bed. Iron in large doses essential. Value of yeast and 'liver' uncertain, but possibly of use.

SEVERE GRADES.—Not uncommon. Blood transfusion essential for these. Otherwise little or slow response to treatment, and anæmia may persist for months or years.

Megalocytic Anæmia: Pernicious Anæmia of Pregnancy.—

ONSET AND COURSE.—Symptoms rarely appear before later months of pregnancy. Previous anæmia in some but not all. Symptoms increase until confinement. In some cases symptoms only appear at confinement. Subsequent to confinement symptoms may (a) spontaneously subside, (b) rapidly aggravate. Prognosis bad if sepsis present. No spinal cord changes.

SYMPTOMS.—Pallor extreme: may develop rapidly. Patient sallow, but jaundice rare. Pyrexia. Dyspnœa, vomiting, diarrhœa. May be severe œdema. Purpura and hæmorrhages in very severe forms. Spleen may be palpable.

BLOOD CHANGES.—Considerable variations.

1. **RED CELLS AND HÆMOGLOBIN.**—As in severe pernicious (megalocytic) anæmia. Red cells often about 1,000,000. Megalocytes, numerous megaloblasts, and normoblasts; polychromasia. Reticulocytes may be high before treatment.
2. **COLOUR INDEX.**—Variable. May be over 2 or below 1.
3. **LEUCOCYTES.**—Usually increased: may be 10,000 to 20,000. Myelocytes and myeloblasts often present.
4. **VAN DEN BERGH'S TEST.**—Indirect positive.

TREATMENT.—

1. Blood transfusion. Indicated in all severe cases. May need repetition.
2. Iron.
3. Liver or yeast (often sufficient in tropical anæmia).

III. HÆMOLYTIC ANÆMIA.

May occur at puerperium due (perhaps not invariably) to infection with hæmolytic streptococci.

CHAPTER CXXIX.

HÆMORRHAGIC DISEASES AND DIATHESIS.

A group of conditions in which without direct trauma extravasation of blood from the capillaries tends to take place into the skin and other tissues and from the mucous membranes. Active state may be continuous or intermittent. Purpura is a common manifestation, but is not invariably present.

Pathogenesis of the group is obscure, and probably varies in different types.

Classification.—

I. PRIMARY NON-HEREDITARY HÆMORRHAGIC DIATHESIS.—

1. HÆMORRHAGIC PURPURA.—
 - a. Acute.
 - b. Chronic.
2. ANAPHYLACTOID PURPURA.—
 - a. Henoch's purpura.
 - b. Purpura rheumatica.

II. SYMPTOMATIC HÆMORRHAGIC STATES OR SECONDARY PURPURA.—

1. INFECTIOUS FEVERS.—(a) Eruption hæmorrhagic as in typhus, cerebrospinal fever, small-pox, and occasionally measles, scarlet fever; (b) General hæmorrhagic state during or after attack (rare).
2. SEPTIC INFECTIONS.—Septicæmia, pyæmia. Infective endocarditis.
3. DISEASES OF BLOOD-FORMING TISSUES.—E.g., leukæmia, aplastic anæmia.
4. ORGANIC AND INORGANIC SUBSTANCES.—Salvarsan, sanocrysin, benzol derivatives, and other drugs. Snake poison. Iodides, quinine, belladonna. Sensitivity to proteins.
5. CACHECTIC CONDITIONS AND CHRONIC NUTRITIONAL DISTURBANCES.—Neoplasms, chronic nephritis, old age. Miliary tuberculosis.
6. ACUTE NECROSIS OF ORGANS.—May be due to syphilis or other toxins, e.g., acute yellow atrophy.
7. MECHANICAL.—From venous stasis or severe muscular contractions. Whooping-cough. Epilepsy. Tabes.

Note.—This group is not further directly referred to. Features similar to primary group, complicated by causal disease.

III. HEREDITARY HÆMORRHAGIC DISEASES.—

1. HEREDITARY HÆMORRHAGIC DIATHESIS.—
 - a. Features similar to non-hereditary group.
 - b. Types intermediate between hæmorrhagic diathesis and hæmophilia.
2. HÆMOPHILIA.—*See* p. 724.
3. HEREDITARY HÆMORRHAGIC TELANGIECTASIA.

IV. HÆMORRHAGIC DEFICIENCY DISEASES.—

1. SCURVY.—*See* p. 378.
2. MELÆNA NEONATORUM.—*See* p. 748.
3. DELAYED COAGULATION TIME due to defect of fibrin (fibrinopenia) or calcium (hæmophilia calcipenia).

Pathogenesis of Capillary Hæmorrhage.—Factors concerned in capillary hæmorrhage are: (1) Capillary permeability; (2) Blood-platelets; (3) Bone-marrow; (4) Spleen. Variations in the coagulation time and the character of the clot are results and not causal factors.

1. CAPILLARY PERMEABILITY.—Permeability is increased and thus permits escape of blood constituents. Capillaries shown

Pathogenesis of Capillary Hæmorrhage, *continued*.

experimentally to be dilated and blood-current not slowed. Defect is probably inability of capillary wall to contract. Similar capillary state in wheal formation and urticaria—i.e., escape of plasma without cells—and after histamine injections.

Increased permeability alone without other factors can result in capillary hæmorrhage, as after snake bites.

Cause of increased permeability unknown, but may be due to presence or absence of some secretion from spleen.

2. BLOOD-PLATELETS.—These tend normally to prevent capillary hæmorrhages by: (a) Adhering in masses to intima at weak or damaged spots; (b) Aiding in coagulation of blood.

THROMBOCYTOPENIA may arise: (a) From interference in formation; thus in certain hæmorrhagic diseases with extreme thrombopenia, bone-marrow contains excess of megakaryocytes, consistent with arrest of development (cf. pernicious anæmia). (b) From lack of formation, e.g., aplastic anæmia. (c) From capillary hæmorrhages of any origin, considerable numbers of plates being destroyed in masses where they adhere to weak sites. Bone-marrow, under pressure, produces giant or defective platelets, rapidly destroyed by spleen.

INFLUENCE OF THROMBOCYTOPENIA.—*Note*: (a) Hæmorrhages not invariable when platelets low or absent. (b) Hæmorrhages may commence when platelets near normal, but fall off subsequently. (c) Hæmorrhages may cease while platelets low or absent—usually subsequent rise. (d) After splenectomy usually marked rise, often with fall later. *Note especially* (e) Platelets may fall before hæmorrhages appear (anæmia also present).

Above statements apply to all forms of hæmorrhagic diathesis and purpura primary or secondary (but see ANAPHYLACTOID PURPURA, p. 722).

COMPLETE ABSENCE OF PLATELETS may occur without development of hæmorrhages and therefore cannot be sole factor, but is contributory factor, and possibly may be initial factor. Variation and reduction in number does not distinguish primary and secondary forms of hæmorrhagic diseases.

3. BONE-MARROW.—Forms platelets. In acute types of hæmorrhagic diseases marrow usually hyperplastic. In chronic cases may be hyperplasia, but in fatal cases usually partial aplasia. *Note*: Hæmorrhage into marrow may simulate hyperplasia.

4. SPLEEN.—Normally destroys effete platelets. Splenectomy may benefit hæmorrhagic diathesis, possibly by action on capillary permeability, or, less probably, by removal of action on bone-marrow and also by permitting defective platelets to circulate (cf. ACHOLURIC JAUNDICE, p. 710).

Frauk believed erroneously that thrombopenia only occurred in acute, severe purpura hæmorrhagica, and ascribed this to

diminished formation of platelets in marrow, considered to be essential cause; this type he regarded as distinct from all other purpuras and called it 'essential thrombopenic purpura hæmorrhagica'. Kaznelson found splenectomy benefited Frank's type. He ascribed original cause of hæmorrhage to increased destruction of platelets in the spleen. The theories of Frank and Kaznelson do not explain the common features of different types of hæmorrhagic diathesis.

SUMMARY.—Increased capillary permeability is essential factor. Thrombopenia is contributory factor, whether resulting from destruction of platelets in protecting vessels or primarily from defective formation.

Changes in Blood.—

CELLS.—No characteristic change: varies with extent of hæmorrhages, chronicity, and reaction of marrow. Main groups: (i) Loss of blood moderate or intermittent: moderate reduction of red cells (rarely erythrocytosis), normal number of leucocytes or leucocytosis. (ii) Loss of blood more severe and chronic (exhausting marrow): severe anæmia, reticulocytosis, leucopenia, relative lymphocytosis. (iii) Acute forms: no constant change except anæmia; may be leucocytosis or leucopenia with relative lymphocytosis. Colour index: high or low.

BLOOD-PLATELETS.—Diminished when hæmorrhages are active or chronic, degree of diminution varying with severity and duration. In chronic, mildly active, or intermittent states, often between 100,000 and 150,000 per c.mm., but may be higher in intervals. In acutely active states, very low: large forms then usually present. Platelets may be completely absent. Number may vary rapidly and rise from zero to normal in few days on cessation of hæmorrhages.

NATURE OF BLOOD-CLOT.—Not firmly formed. Often does not contract and express serum.

COAGULATION TIME.—Estimation often difficult from irregular clot formation. No constant or gross change: varies round normal figure. General tendency to shortened time. Fall in platelets even to zero has no extreme effect, but somewhat prolongs minimum time.

CAPILLARY RESISTANCE TEST.—During active state, causes petechiæ below constriction.

BLEEDING TIME (Duke's Test).—During active state, is markedly prolonged, even to one hour. No relation to coagulation time. Not explicable on ground of reduction of platelets, as complete absence is consistent with only moderate prolongation. Prolongation is closely parallel with degree of hæmorrhages at time of test, and is therefore measure of the hæmorrhagic state.

SPLEEN.—May be palpable in any type.

SUMMARY.—*Capillary resistance test and bleeding test* are the two definite manifestations of activity at time of examination. Normal tests are evidence of inactivity but not proof of absence of hæmorrhagic diathesis. Diminution of platelets may persist in inactive stages.

Hæmorrhagic Diseases and Diathesis, *continued*.

Manifestations Resulting from Increased Capillary Permeability.—Increased capillary permeability may result in escape into soft tissues of: (1) Plasma only; (2) Cells and plasma—i.e., whole blood.

1. **ESCAPE OF PLASMA ONLY.**—Exudation *without discoloration* into:—

- a. **SKIN OR SUBCUTANEOUS TISSUES.**—Produces firm tender areas *not discoloured*.
- b. **JOINTS AND NEIGHBOURING TISSUES.**—Causes pain and swelling of joints.
- c. **ALIMENTARY CANAL.**—Causes pain and colic, may be diarrhœa and vomiting: congestion may lead to blood and mucus per rectum.

Not associated with anæmia, alterations in platelets, or other blood changes. Recovery rapid. Merges into angioneurotic œdema (pathogenesis similar).

Note.—This group is only referred to in this chapter when combined with some escape of cells—i.e., 'anaphylactic purpura'.

2. **ESCAPE OF BLOOD.**—Results in:—

- a. **PURPURA.**—Petechiæ.
- b. **HÆMORRHAGE FROM MUCOUS MEMBRANES.**—Spontaneous or after trauma, e.g., tooth extraction.

Mucous Membranes Affected.—Nose and gums commonest: may occur from any sites—eg., menorrhagia, hæmaturia.

Recurrent hæmorrhages may take place from same site.

Either (a) or (b) may occur alone in milder grades.

Anæmia, alterations in platelets and bleeding time, and positive capillary resistance test develop in this group.

NOTES.—

1. The two types, escape of plasma and escape of blood, often occur in same case and are recognizable at different sites.
2. Colic and joint swellings may result from blood, but this is rare and only in very severe grades.
3. *Ecchymosis*. Is mainly escape of plasma, discoloured by small amount of blood.

MANIFESTATIONS OF INCREASED CAPILLARY PERMEABILITY.—It is evident from the above that these may be divided into three groups:—

1. **PURE URTICARIA.**—

Characteristics.—Œdematous areas, joint swellings, colic, no anæmia.

2. **PURE HÆMORRHAGIA.**—

Characteristics.—Hæmorrhages, blood changes.

Classical Types of 'Purpura'.—Simplex to hæmorrhagica.

3. **COMBINATIONS OF ABOVE GROUPS.**—

Characteristics.—External hæmorrhage may be slight, but appearance may be greatly exaggerated by discoloration of large areas of œdema.

Classical Types of 'Purpura' (plasma predominating).—*'Anaphylactoid'* group—viz., Henoch's purpura and purpura rheumatica.

PRIMARY NON-HEREDITARY HÆMORRHAGIC DIATHESIS.

Classification.—The clinical types depend on:—

1. Severity of hæmorrhages, resulting in (a) external manifestations, (b) anæmia.
2. Relative escape of plasma and whole blood respectively.

Four groups commonly described:—

1. Purpura simplex—mild hæmorrhagic type.
2. Purpura hæmorrhagica—severe hæmorrhagic type.
3. Henoch's purpura—'anaphylactoid' purpura; mainly plasma. Applied to cases with prominent abdominal symptoms.
4. Purpura rheumatica—'anaphylactoid' purpura; mainly plasma. Applied to cases with prominent joint symptoms.

These four types correctly belong to two groups: (I) Predominantly hæmorrhagic—includes first two types varying in severity from purpura simplex to purpura hæmorrhagica; classified here as (1) acute, (2) chronic. (II) 'Anaphylactoid' purpura: escape in different sites of plasma and whole blood. Includes (1) Henoch's purpura, and (2) purpura rheumatica.

I. HÆMORRHAGIC PURPURA.

1. Acute Type.—

AGE AND SEX.—Both sexes and at any age; commonest in childhood and at puberty.

ONSET.—Acute symptoms usually sudden: with or without previous hæmorrhagic tendencies. Previous malaise for several days common: anæmia may have developed. Often, but not always, previous debility.

SYMPTOMS.—Hæmorrhages of all types.

- a. Superficial hæmorrhages: purpura, ecchymoses. Often tender areas without discoloration from effusion of plasma.
- b. Extensive hæmorrhages from mucous membranes.
- c. Fever usual, irregular. Severe constitutional disturbances. Vomiting and diarrhœa common. Spleen may be palpable.
- d. Joint and abdominal pains may be present.

BLOOD.—Extreme thrombopenia at onset or rapidly develops: often giant platelets. Capillary resistance test and Duke's bleeding test positive and measure activity at moment of test. For other changes, see CHANGES IN BLOOD (p. 719).

COURSE.—Progressive weakness; extreme discomfort, rapid anæmia. May be rapidly fatal from exhaustion or cerebral hæmorrhage. But hæmorrhages may cease at any stage, with recovery; usually drift into chronic type.

2. Chronic Type.—Hæmorrhagic state is constitutional. May commence at any age. May be intermittent or continuous, but of the latter only milder forms are consistent with long duration.

Every grade from few purpuric spots to severest hæmorrhagic state may occur or develop at any stage.

Hæmorrhagic Purpura—Chronic Type, *continued*.

Recurrent attacks in a given individual may be: (a) All of same type, e.g., purpura with epistaxis, or hæmaturia or menorrhagia alone; (b) Of varying types, e.g., simple purpura, urticaria, hæmorrhages from mucous membranes in consecutive attacks. Spleen may be palpable.

BLOOD.—Changes variable, depending both on chronicity and severity at time of examination. In moderate severity platelets often 100,000 to 150,000. Capillary resistance and Duke's tests are measures of activity at moment, but if negative do not exclude liability to recurrence.

COURSE.—May continue or recur throughout life, with various degrees of anæmia.

II. 'ANAPHYLACTOID' PURPURA.

1. Henoch's Purpura.—Mainly due to exudation of plasma, with varying amount of hæmorrhage. Occurs at any age, but commonest in younger decades.

ONSET.—Acute, acute on chronic, or recurrent. Few days' previous malaise frequent.

SYMPTOMS.

1. Ecchymoses: variable extent. May be large areas, erroneously suggesting extensive hæmorrhage. Purpura often absent or scanty. Tender œdematous areas or urticarial swellings.
2. Abdominal colic. May be diarrhœa or constipation, and vomiting.
3. Joints may be painful and swollen: no discoloration.
4. Constitutional disturbances often considerable: touching is painful owing to tender areas.

BLOOD.—Changes usually slight. Platelets may be normal or somewhat low, 100,000 to 150,000. Spleen may be palpable.

COMPLICATIONS.—Intussusception often closely simulated: blood and mucus may be passed per rectum; intussusception may actually develop from invagination of œdematous area. Appendicitis also occurs. Intracranial œdema may cause coma or death (simulating uræmia); occasionally hæmorrhage.

COURSE.—May be recurrences for several years: tendency to diminish. Recovery from attacks often surprisingly rapid (little blood effused). Hæmorrhages rarely may increase and progress to grade of purpura hæmorrhagica.

2. Purpura Rheumatica.

SYNONYM.—Schönlein's disease. (*Note:* Schönlein called his disease 'peliosis rheumatica'; he left no clear account of it.)

SYMPTOMS.—Closely akin to Henoch's purpura, but term applied especially to type with marked joint and less prominent abdominal features. Sore throat sometimes at onset.

DIAGNOSIS FROM ACUTE RHEUMATISM.—No previous rheumatic manifestations; no endocarditis; salicylates have no effect. Purpura very rare in acute rheumatism.

GENERAL DIAGNOSIS.

Hæmophilia.—Usually simple. In hæmophilia: (1) Coagulation time greatly prolonged; (2) Hæmorrhages not spontaneous; (3) No purpura; (4) Hereditary (nearly always). Rarely but occasionally difficult.

Splenic Anæmia.—May be very difficult. (*See* SPLENIC ANÆMIA.)

Aplastic Anæmia.—May terminate with hæmorrhages, and diagnosis at such stage is impossible clinically.

Local Hæmorrhages from Mucous Membranes (e.g., menorrhagia, recurrent hæmaturia).—Diagnosis of hæmorrhagic diathesis in absence of purpura only justified by blood examination.

Acute Lymphoid Leukæmia (aleukæmic type).—May be difficult.

TREATMENT.

Blood Transfusion.—Indicated in all acute cases. Compatibility of donor to be carefully proved. About 200 to 300 c.c. May be repeated. Influence on hæmorrhagic state is doubtful.

Splenectomy.—

1. **ACUTE TYPE.**—Operative risk high. Consider operation if at end of 24 hours and two blood transfusions hæmorrhages continue, bleeding time still excessive, hæmoglobin falling, and constitutional disturbances increasing.

RESULTS.—Good in survivors. Hæmorrhages cease, occasionally instantaneously. Platelets rise.

Note: Possibility of spontaneous cessation and recovery at any stage must be borne in mind.

2. **CHRONIC AND 'ANAPHYLACTOID' TYPES.**—Operative mortality about 15 per cent.

INDICATIONS.—Consider operation only if condition sufficiently severe to warrant operative risks. Note age and general physical condition, fitness for work, previous history, severity of hæmorrhages, degree of anæmia, evidence of increasing severity. Platelets below 100,000 favour operation. Above 150,000 may increase risk of subsequent thrombosis: does not necessarily exclude operation.

SUBSEQUENT COURSE.—Hæmorrhages may cease immediately and permanently or continue in slight degree for period before ceasing. Platelets rise high but later fall; if thrombopenia, hæmorrhages will return. Recurrence may develop after long periods of freedom. Occasionally no improvement or rise in platelets.

Local Treatment.—Snake venom may check local hæmorrhages.

Antiscorbutic treatment: Intravenous injections of vitamin C worth trial: useless by mouth. (*See* VITAMIN C, p. 367.)

Methods of doubtful value: Hæmostatic serum, calcium, liver, ultra-violet rays valueless. Protein shock by injections of T.A.B. vaccine dangerous. Horse serum may have transient effect in 'anaphylactoid' type. X-ray applications of uncertain value. Adrenaline injections occasionally useful in children.

HEREDITARY HÆMORRHAGIC DISEASES.**HEREDITARY HÆMORRHAGIC DIATHESIS.**

Etiology.—May be transmitted by and affect both sexes.

Symptomatology.—As in non-hereditary group. Reduction of platelets and other features similar.

Treatment.—Based on same principles as in non-hereditary group: decision on splenectomy with greater caution; has given good results in some recorded cases, but may be fatal usually with absence of rise of platelets.

Types intermediate with Hæmophilia.—Cases occur in which diagnosis is doubtful between hæmorrhagic diathesis and hæmophilia. Very rare. Features vary—e.g., coagulation time prolonged with or without variation in platelets, etc. Has occurred in females of hæmophilic stock. May also be sporadic. Erroneously termed 'pseudo-hæmophilia'.

HEREDITARY HÆMORRHAGIC TELANGIECTASIA.

A hereditary disease characterized by formation of multiple telangiectases, rupture of which results in hæmorrhages.

Etiology.—Transmitted and exhibited by both sexes: behaves as Mendelian dominant. Half the members of family affected.

Pathogenesis.—Probably dysplasia of capillary system.

Symptoms.—

EPISTAXIS.—Earliest symptom: commences in childhood.

TELANGIECTASES.—Not present at birth: recognized about third decade: gradually increase in number, each lesion remaining permanently. Many types—e.g., pin-point, spider-shaped stellate vessels, or nodular.

SITE.—Face, mouth, tongue, nasal mucous membrane commonest: no site immune.

HÆMORRHAGES.—Epistaxis commonest, but occur from all sites.

BLOOD.—Microcytic anæmia.

Course.—No specific treatment: cauterization of slight value. *Cirrhosis of liver* may develop: probably associated dysplasia.

CHAPTER CXXX.**HÆMOPHILIA.**

An hereditary abnormality, limited to males but transmitted by females, characterized by a tendency to excessive hæmorrhage from slight injuries and by prolonged coagulation time of blood.

Etiology.—The prototype of hereditary diseases. 'Law of Nasse' holds good: transmitted only by females and exhibited only by males. Tendency to bleed exists in females as a Mendelian sex-linked recessive character: hence theoretically under special

circumstances can be transmitted by males and exhibited by females; no unequivocal example known, but females of family may bleed somewhat readily. Linkage with colour-blindness under discussion. Latin races said to be immune. Females tend to great fecundity. In successive generations, percentage of bleeders usually diminishes. Severity of conditions varies in different families.

Pathology.—*Coagulation of blood* is delayed. Cause is an abnormality of fibrin formation.

NORMAL CLOTTING is commonly explained as follows:—

MORAWITZ'S THEORY.—Clotting is formation of insoluble fibrin from circulating fibrinogen.

Factors concerned are: (1) Fibrinogen: contained in plasma. (2) Prothrombin: probably mainly from disintegration of platelets, some from leucocytes: little in plasma. (3) Thrombokinase (thromboplastic substance): contained in all cells, e.g., walls of blood-vessels. (4) Calcium.

First Stage.—Prothrombin is converted by thrombokinase, in presence of calcium, into thrombin (or fibrin ferment), which is thus always formed when blood meets other cells.

Second Stage.—Fibrinogen is converted by thrombin into fibrin—i.e., clot forms.

CAUSE OF DELAYED CLOTTING IN HÆMOPHILIA.—

Evidence incomplete, but:—

1. Fibrinogen not at fault, as clot when formed is normal.
2. Calcium is not deficient in amount.
3. Thrombokinase and prothrombin from hæmophilic blood have shown no abnormality when examined by action in clotting other blood (experiments not very conclusive).

Error is probably in formation of thrombin, either (1) deficiency of thrombokinase—i.e., error fundamentally in tissue-cells and not in blood, or (2) undue stability of elements which form prothrombin. Clots may be present in wound, yet bleeding continue.

Changes in Blood.—

BLOOD-CELLS.—Anæmia after hæmorrhage.

BLOOD-PLATELETS.—Usually normal (but may fall after hæmorrhage).

COAGULATION TIME.—In given individual varies at different periods. Usually greatly prolonged. Curve is abnormal (see p. 685): falls in second and third drops and rises again rapidly. May be 10 to 60 minutes or more.

BLEEDING TIME.—Usually normal.

CAPILLARY RESISTANCE TEST.—Negative.

Symptoms.—Constant liability to excessive hæmorrhage from slight injuries. Usually commences in early infancy, but is rare at birth (i.e., hæmorrhage from navel); tendency diminishes with age; also varies greatly at different times.

Hæmophilia—Symptoms, *continued*.

ONSET AND CHARACTER OF BLEEDING.—Probably *always trauma*, but often trivial. A slight abrasion persists in bleeding, dripping like a sponge, not abnormally profuse in rate, but prolonged in time.

SITE OF HÆMORRHAGE may be:—

1. **EXTERNAL.**—Tooth extraction, epistaxis, gums especially. No site, however, is exempt. Cuts, even when trifling, circumcision, etc. Ecchymoses. *Never purpura*.
2. **INTERNAL.**—Subcutaneous or intramuscular hæmatoma, often large and spreading, following slight trauma.
3. **JOINTS.**—Few hæmophilics escape. Mainly large joints, especially knee. Bleeding rapid. Blood may be absorbed completely and leave no sequel; or organization and ankylosis may result.
4. **SPINAL CORD.**—Transverse myelitis may result.

From stomach, kidney, lung: rare.

Diagnosis.—Essential points are: (1) In males only; (2) *Repeated prolonged* hæmorrhages, on *slight* provocation, commencing in *infancy*; (3) Delayed coagulation of blood; also (4) Hereditary; (5) Transmitted by females only. Diagnosis from hæmorrhagic diathesis.

Prognosis.—Worst in childhood: improves with age. Severity varies in different families.

Treatment.—

CAREFUL PROPHYLAXIS in susceptible persons.

LOCAL TREATMENT.—Gently wash clot from site. Apply snake venom (Russell's viper), 1-10,000, firmly on cotton-wool: or fresh human blood.

BLOOD TRANSFUSION.—Renders coagulation time normal for about 5 days. Always indicated before operations.

Various methods useless or under trial: ovarian extracts, protein injections, calcium, placental extracts, serum injections.

CHAPTER CXXXI.

ERYTHRÆMIA.

(Vaquez's Disease. Osler's Disease. Polycythæmia Vera.)

A disease characterized by increase in number of red cells and total blood volume, and clinically by congested appearance and splenomegaly.

Etiology.—

AGE.—35 to 60 years.

Commoner in males. Occasionally familial.

No syphilitic factor.

Pathology.—Bone-marrow active; purple colour; hyperplasia of both erythroblastic and leucoblastic tissues; many myeloblasts

present. Hence disease considered a *primary hyperplasia of erythroblastic marrow tissue*, corresponding to leukæmia (but more probably secondary).

Symptoms.—Headache, giddiness, fainting attacks. Congested facies. May be transient paralyses. Pain from perisplenitis. May be epistaxis and other hæmorrhages, but amount rarely severe. Worse in cold weather.

Physical Signs.—

1. **APPEARANCE.**—*Plum-coloured*: (cyanosis if cold). General congestion: all vessels dilated. Lips and ears purple.
2. **SPLEEN ENLARGED.**—Usually to umbilicus: painless, hard. *Blood-pressure* moderately raised. Albuminuria common. Liver palpable. Cardiac hypertrophy not common.

Blood Changes.—

1. **VOLUME.**—Often double normal.
2. **RED CELLS.**—Numbers: 7 to 12 million per c.mm. Appearance normal: few normoblasts and reticulocytes present.
3. **LEUCOCYTES.**—Number: 15,000 to 20,000, mainly polynuclears. Some myelocytes.
4. **HÆMOGLOBIN.**—120 to 160 per cent. Colour index diminished. Viscosity greatly increased. Platelets increased. Uric acid high. Fragility normal. Coagulation time: usually rapid.

Course and Prognosis.—No cure, but often long duration with intermissions. Anæmia and leucopenia may develop later (probably from aplasia). Rarely myeloid change in leucocytes suggestive of myeloid leukæmia, 'erythro-leukæmia' (see LEUCO-ERYTHROCYTOSIS). Symptoms of peripheral artery disease, e.g., Raynaud's. Death from: (1) Cardiac failure; (2) Thrombosis, e.g., cerebral.

Diagnosis.—From other forms of erythrocytosis, from cyanosis from coal-tar products, from methæmoglobinæmia.

Treatment.—

BLOOD-LETTING.—Remove 10 to 30 oz.: repeat in few months.

PHENYLHYDRAZINE HYDROCHLORIDE.—Dose: 2 to 4 gr. daily in cachets for 5 to 7 days; course can be repeated. Very powerful drug: causes rapid reduction of red cells. Good results, but transient. Blood-count must be watched frequently. Drug must not be pressed, as action continues after withdrawal and aplasia may result. Maintenance dose can be given. Acetyl-phenyl-hydrazine also in use.

X-RAY APPLICATIONS.—Some effect. To the long bones. *Splenectomy* is contra-indicated.

Gaisböck's Disease.—'Polycythæmia hypertonica'.

SPECIAL FEATURES.—Blood-pressure high: spleen not enlarged: cerebral hæmorrhage common. Polycythæmia may be transient.

Phenylhydrazine contra-indicated by renal disease.

Erythræmia, continued.

Erythrocytosis.—An increase in the number of the red cells also results from conditions hindering supply of oxygen to the tissues, and is termed erythrocytosis. Spleen is not enlarged. Such conditions are: (1) High altitudes. (2) Congenital heart disease. (3) Ayerza's disease. (4) Thrombosis of portal vein (spleen enlarged). (5) Visceral syphilis. (6) Pituitary basophilism.

CHAPTER CXXXII.

LEUCOCYTOSIS AND LEUCOPENIA.

Polynuclear Leucocytosis.—Increase usually both in (1) total leucocytes, and (2) percentages of neutrophil cells. Occurs in:—

1. Acute infections, especially by pyogenic cocci.
2. Intoxications and drugs. Various: e.g., diabetic coma, uræmia, cirrhosis of liver; salicylates, benzol derivatives (in small doses).
3. Generalized stages of many conditions: e.g., neoplasms, tuberculous and other forms of adenitis. (*See LEUCO-ERYTHROBLASTOSIS.*)
4. Severe hæmorrhages and trauma. Pregnancy: about puerperium. Splenectomy.

Total leucocytes may be 10,000 to 30,000 or rarely 100,000 per c.mm. Cells are more primitive than normal, nuclei being less subdivided—i.e., 'shift to the left' on Arneeth or Schilling counts; may be myelocytes.

In very severe infections, may be leucopenia: percentage of polynuclear cells usually very high (80 to 90).

Lymphocytosis.—*Absolute lymphocytosis* is increase both in (a) total leucocytes, and (b) percentage of lymphocytes. Occurs in: (1) Leukæmia and various neoplastic conditions involving lymphoid tissue; (2) Whooping-cough; (3) A group of 'lymphotropic' infections—e.g., glandular fever, rubella. Never in septic infections. In infants, percentage of lymphocytes is normally high (about 40) up to age of six years, and frequently increases in pyrexial conditions. *Relative lymphocytosis* is due to reduction of neutrophils, as in debilitating conditions and certain specific fevers; also in agranulocytosis. Reduction of lymphocytes may occur in vitamin deficiency and excessive X-ray treatment.

Eosinophilia.—Over 4 per cent is an excess; may rise to 50 per cent or higher. Occurs in following, but not invariably:—

1. *Intestinal parasites*: including tape-worms, ascaris, thread-worms, hydatid cysts, ankylostoma, trichinella, filaria, bilharzia.
2. *Skin diseases*, e.g., psoriasis.
3. *Allergic conditions*, e.g., serum reactions, asthma.

4. *Myeloid leukæmia. Erythræmia.*
5. *Lymphadenoma*: slight, not invariable, not diagnostic.
6. *Convalescence from fevers.* Reported in acute stages of rheumatic and scarlet fever.
7. *Feeding with whole liver.*
8. *Tropical non-parasitic and familial eosinophilia.* Obscure: may be transient: indefinite symptoms.
9. *Eosinophilic leukæmia.*
10. *Emetine treatment.*

Eosinopenia.—In acute infections and specific fevers.

Monocytosis.—Knowledge of monocytes is recent and scanty, and care should be taken in drawing deductions from presence of monocytosis. Occurs in: monocytic leukæmia; glandular fever, rubella, and later stages of acute infectious fevers. Stated to be of diagnostic value in sympathetic ophthalmitis, endocarditis lenta, and miliary tuberculosis.

Basophils (Mast Cells).—Increased in myeloid leukæmia: important, as the increase persists during remissions. Diminished in acute infections.

Leucopenia.—Under 4000 per c.mm. is abnormal. Term correctly implies diminution of all white cells, but generally applied to and nearly always due to diminution of neutrophils (neutropenia), and thus associated with relative lymphocytosis.

MODERATE GRADES.—Influenza, measles, mumps, enteric, undulant fever; debilitating states; anaphylactic shock, transient (retention of neutrophils in spleen). No symptoms.

EXTREME GRADES.—Liable to secondary infections.

1. *Blood diseases and diseases of bone-marrow*: Aplastic anæmia, aleukæmic leukæmia, pernicious anæmia.
2. *Severe intoxications and poisoning*: Benzol compounds. Mustard gas. Gold, arsenic, and heavy metals. X rays and radium.
3. *Agranulocytosis*: Red cells and platelets may be normal in this type.

CHAPTER CXXXIII.

THE LEUKÆMIAS.

Leukæmia is a disorder of the blood-forming tissues, characterized specially by the presence in the circulating blood of precursors of the normal leucocytes in predominating proportions. Pathogenesis is unknown. Invariably fatal.

Classification of Leukæmia.—There are three main hæmopoietic systems:—

1. *Bone-marrow or myeloid tissue*: concerned normally in formation of granular leucocytes and red cells.
2. *Lymphoid tissue*, comprising lymphatic glands and all small accumulations of lymphoid tissue: concerned normally in formation of non-granular leucocytes or 'lymphocytes'.

Classification of Leukæmia, *continued*.

3. *Reticulo-endothelial* or '*histiocytic*' tissue: concerned directly in formation of 'monocytes' ('large mononuclears').

These systems are affected separately in leukæmia, constituting different types, characterized by the presence in the blood in predominating proportions of immature cells of the respective system. In addition to these three types, there are numerous conditions resembling leukæmia in varying degrees: as the classification of these is uncertain, and it is doubtful if some are leukæmic, they are placed together in a group.

CLASSIFICATION.—

1. Myeloid leukæmia: (a) Acute (myeloblastic); (b) Chronic.
2. Lymphoid leukæmia: (a) Acute; (b) Chronic.
3. Monocytic leukæmia: acute.
4. Various atypical leukæmias and conditions resembling leukæmia.

NOTE.—The three acute types are practically indistinguishable clinically and will be described together. Monocytic leukæmia is the rarest type; no chronic form is recognized. Chronic myeloid is the commonest type. Large lymphocytic lymphoid is the most chronic type, but very rare.

Notes on Types of Leucocytes with Reference to Leukæmia.—**A. MYELOID SYSTEM.**—

MYELOBLASTS.—Non-granular mononuclear cells; large nucleus, with definite chromatin structure, containing several distinct *nucleoli*, and surrounded by zone of deep-blue cytoplasm. Non-phagocytic. Oxidase reaction negative. Not present in normal blood, but numerous in bone-marrow. Are precursors of myelocytes and polynuclear cells. Two types occur in leukæmic blood:—

Large Myeloblasts.—Broad zone of cytoplasm; nuclei stain comparatively lightly, and nucleoli are easily recognized.

Small Myeloblasts.—Resemblance to small lymphocytes often close.

Occurrence of Myeloblasts in Blood.—(1) Myeloblastic leukæmia. (2) Chronic myeloid leukæmia: invariably present, usually in small numbers (a few per cent). (3) Occasionally, in very small numbers, in conditions of great activity of bone-marrow, e.g., severe leucocytosis.

MYELOCYTES.—Granular mononuclear cells of bone-marrow origin. Phagocytic. Oxidase reaction positive. Are precursors of polynuclear leucocytes, and intermediate and transitional forms occur. *Granules* may be fine neutrophil, eosinophil, or basophil (and rarely amphophilic, all types being present). *The nucleus* is oval or circular; in intermediate forms, horseshoe or showing signs of division. No nucleoli are present. The common type is the finely granular *neutrophil myelocyte*.

Occurrence of Myelocytes in Blood.—(1) In chronic myeloid leukæmia: is characteristic cell. (2) In small numbers

in all conditions of great activity of bone-marrow—e.g., severe leucocytosis (sepsis).

TRANSITIONAL STAGES.—Cells occur which are intermediate stages between myeloblasts and myelocytes, and also between myelocytes and normal leucocytes. In general their numbers are small, but occasionally in leukaemia the predominant cell may be of such type—e.g., a late myeloblast, possessing some granules, with absence of nucleoli or similar feature.

B. LYMPHOID SYSTEM.—

LYMPHOBLASTS.—Are precursors of lymphocytes. May closely resemble myeloblasts.

C. RETICULO-ENDOTHELIAL OR HISTIOCYTIC SYSTEM.—

Is site of formation of monocytes (*see* MONOCYTOSIS, p. 729.)

In Leukæmia—The cells include: (a) Typical large mononuclears, (b) Larger cells with less 'cloudy' cytoplasm, the so-called 'monocytic', precursors of normal mononuclears, (c) Cells with clear cytoplasm, not unlike myeloblasts—usually very fragile.

I. ACUTE LEUKÆMIA.

An acute fatal disease characterized by the presence in the blood of a high proportion of primitive mononuclear or closely similar cells.

The three principal types are: (1) Acute myeloblastic or myeloid leukaemia; (2) Acute lymphoblastic or lymphoid leukaemia; (3) Monocytic leukaemia.

The clinical symptoms and course in the three types are closely similar and will be described together. Special features are noticed subsequently. The determination of the type of the predominant cell is of pathological interest, but not of clinical importance. Distinction is often difficult owing to similarity of myeloblasts, lymphoblasts, and certain histiocytes or monocytes. All forms are rare.

Certain atypical leukaemias may be acute, e.g., chloroma.

Etiology.—

AGE.—Usually under 20 years.

SEX.—About 2 males to 1 female.

No predisposing diseases or factors.

Symptoms and Signs.—Prominent features, any one of which may first attract attention, are:—

1. **PALLOR.**—Anæmia is severe even at first examination, and becomes extreme. Marked exhaustion.
2. **SWELLING AND ULCERATION OF GUMS**, also cheek, tonsils, etc.—Often great severity.
3. **HÆMORRHAGE.**—Frequency: gums, nose, stomach, rectum; in females often vaginal.
4. **PURPURA.**
5. **ENLARGEMENT OF LYMPHATIC GLANDS.**—Occurs in most cases, but is rarely very great.

Other features are:—

6. **ENLARGEMENT OF SPLEEN.**—Palpable in 75 per cent, but never attracts attention initially; usually slight; rarely reaches to umbilicus finally. LIVER usually enlarged.

Acute Leukæmia—Symptoms and Signs, *continued*.

7. VOMITING.—Often intractable towards end. Diarrhœa less common.
8. FEVER.—Rarely absent: often 103° to 104° .
9. TUMOURS AND NODULES.—Collections of leucocytes may form nodules or masses in any site,—e.g., skin, gums, mediastinum—in the more prolonged cases.

Course.—Initial symptom of pallor, with or without oral symptoms and hæmorrhage, may be followed rapidly by enlargement of spleen and glands and by hæmorrhages and purpura. In some cases glands and spleen do not enlarge throughout. Disease progresses continuously, and weakness increases rapidly, especially in this latter group. Remissions are rare. Vomiting usually troublesome. General condition of extreme discomfort. May be no hæmorrhages, and death from anæmia and exhaustion.

Prognosis.—Death invariable in short period, often within few days to few weeks from date of observation: occasionally few months.

Diagnosis.—Symptoms usually, but not invariably, lead to examination of the blood; recognition simple from predominance of a mononuclear cell.

Condition clinically may be confused with:—

1. HÆMORRHAGIC DIATHESIS, PURPURA, SCURVY.—*Note*: Purpura in absence of a palpable spleen is practically never of leukæmic origin.

Acute purpura hæmorrhagica may simulate acute leukæmia.

2. ANGINA.—In any case of ulceration within mouth, or swelling of gums *which is resistant to treatment*, the blood should be examined.
3. INFECTIVE ENDOCARDITIS, SEPTICÆMIA, ETC.—From presence of purpura and pyrexia.

Note.—In extreme degrees of polynuclear leucocytosis occurring in infections—e.g., 100,000 or more per c.mm.—myelocytes are often present in fair numbers. May be mistaken for leukæmia, especially with septic spleen, etc.

4. ACUTE SPECIFIC FEVERS.—Hæmorrhagic or toxic types, e.g., typhoid, typhus.
5. MONONUCLEOSIS.—Occurs in glandular fever and other conditions. (*See p. 729*.)
6. AGRANULOCYTOSIS.

Treatment.—*Palliative*. X rays, arsenic, etc., valueless, but may be tried; latter usually causes or increases vomiting.

VARIETIES OF ACUTE LEUKÆMIA.

1. Myeloblastic Leukæmia.—(a) Primary; (b) Secondary, acute termination of chronic myeloid leukæmia.

THE BLOOD.—Changes similar in primary and secondary forms.

a. LEUCOCYTES.

- i. Number: 30,000 to 200,000 per c.mm. or higher. May be *leucopenia* on first examination, especially in secondary group; numbers may rise rapidly later.

ii. Cells: *Predominant cell is a myeloblast, large or small type; may form 90 per cent or more of total cells. A few myelocytes and polynuclears always present.*

b. ERYTHROCYTES.—Occasionally normal on first examination, but anæmia develops rapidly and becomes extreme. Colour index often high. Normoblasts and megaloblasts: numbers vary, occasionally very numerous.

MORBID ANATOMY.—Spleen and lymphatic glands usually enlarged; there may be a *green* tint on opening glands, evanescent. Bone-marrow red or grayish.

Lipæmia may be present during last few days; serum is opaque milky colour; occasional cause of milky blood. (More correctly, is a *pseudo-lipæmia*, the body present being not fat, but a lipid.)

ACUTE MYELOCYTIC LEUKÆMIA.—Acute course, but blood as in chronic myeloid leukæmia throughout. Very rare.

2. **Lymphoblastic or Acute Lymphoid Leukæmia.**—Lymphatic glands usually but not invariably enlarge.

THE BLOOD.—

a. LEUCOCYTES.—

i. Number: Often *under* 10,000 at first observation; leucopenia common, 2000 to 5000. May be 20,000 to 100,000.

ii. Cells: *Predominant cell is a lymphocyte, almost invariably of small type; may exceed 99 per cent of total. Lymphoblasts scanty.*

b. ERYTHROCYTES.—As in myeloblastic leukæmia.

Rapid variations in number of leucocytes may occur, even to within normal limits; anæmia and general condition not showing corresponding improvement.

MORBID ANATOMY.—Spleen and lymphatic glands enlarged. Bone-marrow increased, little fat, colour red. Hæmorrhages on serous membranes.

HISTOLOGY.—All hæmopoietic tissues contain large numbers of the cell predominating in the blood. Liver may give free iron reaction.

LARGE LYMPHOCYTIC TYPE.—Typical large lymphocytes. Extremely rare.

3. **Monocytic Leukæmia.**—Rare: usually very acute. *Onset* often curiously obscure. Gums especially painful: may be pale swollen masses. Hæmorrhages not invariable; often severe without purpura. Glands usually enlarged.

THE BLOOD.—

a. LEUCOCYTES.—

i. Number: very variable. Leucopenia or large numbers.

ii. Cells: Predominant are histiocytes and large mononuclears: initially often 20 to 30 per cent: increase to 70 to 90 per cent.

b. ERYTHROCYTES.—As in other forms.

II. CHRONIC MYELOID LEUKÆMIA.

(*Splenomedullary Leukæmia.*)

A fatal disorder affecting the myeloid tissue, and characterized by great increase and abnormality of the bone-marrow cells in the blood and enlargement of the spleen.

Etiology.—

SEX.—About 2 males to 1 female.

AGE.—Any decade, commonly 25 to 40 years, rare under 20 years. No predisposing factors known. Never produced experimentally.

Morbid Anatomy.—Important lesions are confined to the hæmopoietic system.

BONE-MARROW.—Medullary cavity occupied by grayish-red tissue; no fat remaining.

HISTOLOGY.—Great hyperplasia of leucoblastic (leucocyte-forming) tissues. Note:—

1. Numerous non-granular large mononuclear cells, viz., myeloblasts.
2. Numerous myelocytes, frequently showing mitosis.
3. Nucleated red cells, both normoblasts and megaloblasts.

SPLEEN.—Always enlarged, often enormous: commonly about 10 pounds.

SURFACE.—Perisplenitis and adhesions common; capsule thickened; veins in hilus enlarged.

ON SECTION.—Tough from sclerosis; general red surface, often scattered gray areas from old infarcts.

HISTOLOGY.—Resembles bone-marrow; no Malpighian corpuscles remain; enormous numbers of leucocytes with numerous myelocytes present. Changes may be transformation into leucoblastic tissue, or the result of infiltration with cells, probably the former.

LYMPHATIC GLANDS.—Perisplenic glands usually unaffected. Mesenteric glands often enlarged. Changes resemble spleen.

Occasionally enlarged glands have green tint on section.

Solitary follicles, Peyer's patches, etc., may be swollen by leucocytes.

BLOOD.—Grayish colour from excess of leucocytes: often clotted.

OTHER TISSUES.—

LIVER.—Enlarged; widespread leucocytic infiltration, distending capillaries; in microscopic sections, resembles miliary abscesses.

KIDNEYS AND LUNGS.—Similar leucocytic infiltration.

HEART.—Blood-clots very common: appearance may resemble pus.

Symptoms.—Onset is insidious.

COMMON INITIAL SYMPTOMS.—

1. **ENLARGEMENT OF ABDOMEN BY SPLEEN.**—Often earliest symptom. Dragging weight.
2. **PAIN IN LEFT FLANK.**—From perisplenitis following thrombosis.

3. LASSITUDE.—May be wasting. Breathlessness.

4. ANÆMIA.—Not marked in early stages, but increases later.

OTHER SYMPTOMS.—

LEUKÆMIC RETINITIS.—Almost constant. Fundus pale, white spots. Sight may or may not be affected. In rare cases is *earliest symptom*. Hæmorrhages in late stages.

FEVER.—Usually slight, irregular, or transient pyrexia.

PRURITUS.—May be no visible skin change.

CRANIAL NERVE PALSIES.—Not uncommon.

AMENORRHŒA.

ŒDEMA.—Œdema of legs common. Pleural effusion occasionally, ascites rare.

URINE.—Enormous excretion of uric acid, from destruction of leucocytes. No gout or 'uric-acid' symptoms.

OCCASIONAL SYMPTOMS.—Priapism: traditional, but rare: due to thrombosis in corpora cavernosa. Ménière's syndrome: sudden onset, from hæmorrhage into semicircular canals. Skin tumours. Thrombosis and phlebitis. Pigmentation of skin: usually purple or red, commencing on head (more frequent in atypical leukæmia).

ENLARGEMENT OF SPLEEN.—Invariable; usually reaches umbilicus or beyond; edge and notch easily felt; surface smooth; may be tender. Varies in size, roughly with number of leucocytes.

LIVER.—Generally palpable.

LYMPHATIC GLANDS.—Not usually enlarged. Most commonly axillary.

TERMINAL STAGE.—Certain symptoms are *infrequent* during chronic stages, but often important *towards termination*, especially if this is acute (myeloblastic):—

HÆMORRHAGES.—Especially nose or gums. Rarely severe until late stages.

PURPURA.—Almost confined to acute termination; *very rare* in chronic stage.

GASTRO-INTESTINAL DISTURBANCES.—Vomiting, diarrhœa, etc. Not uncommon towards end.

The Blood.—Changes are characteristic and pathognomonic. Fresh blood, in severe cases, is grayish-red from excess of leucocytes.

LEUCOCYTES.—*Total number greatly increased*: commonly 200,000 to 300,000; may exceed 1,000,000. Total number of all varieties is increased.

CHARACTERISTICS (in stained blood):—

1. Presence of abnormal granular bone-marrow cells in large numbers, i.e., *myelocytes*. Percentage 10 to 25: less commonly up to 40 or 50.

2. Increase of mast cells, and usually of eosinophils.

Transitional forms between myelocytes and normal leucocytes are numerous. In some cases very few cells are truly normal, the nucleus showing but slight division.

Chronic Myeloid Leukæmia—The Blood, *continued*.

Mast cells (coarsely and finely granular basophils).—Usually in large numbers, forming 5 to 10 or even 25 per cent.

Eosinophils.—Percentage increased.

Myeloblasts.—Invariably present, usually not exceeding 10 per cent.

ERYTHROCYTES.—Number in early stages not greatly diminished; may be normal. Falls as condition advances. Reticulocytes increased.

Colour index usually low, 0.6 to 0.8, but may be unity.

Nucleated red cells, normoblasts and megaloblasts, rarely absent; may occur even in absence of severe anæmia.

BLOOD-PLATELETS.—Little change in chronic stage. Diminished in myeloblastic or hæmorrhagic stages.

SUMMARY OF CHARACTERISTIC CHANGES.—

1. Total number of leucocytes greatly increased.
2. Increase mainly due to granular cells.
3. Presence of myelocytes and primitive bone-marrow cells.

Course and Prognosis.—Hæmorrhages are sign of terminal stages.

INTERCURRENT DISEASES.—Rare. With sepsis, leucocytes may temporarily *diminish* in number. Tuberculosis, pneumonia: rare.

COURSE AND DURATION.—*Recovery never occurs*. Death from: (1) exhaustion with or without hæmorrhages; (2) myeloblastic termination (rare). Duration *before* observation, probably about 1 year; under observation usually 1 year; rarely exceeds 3 years. Two groups can be recognized.

1. **UNDER 35 YEARS**.—Tendency to great variations in numbers of leucocytes and general condition. Response to X rays usually marked, general improvement temporarily occurring. 'Aleukæmic intervals' may occur, when blood is practically normal, but *mast cells always remain abnormal*. Myeloblastic termination may occur.

2. **OVER 35 YEARS**.—Under treatment, little change in blood and general condition.

MYELOBLASTIC TERMINATION.—Occasionally high percentage of myeloblasts appears suddenly (40 to 98 per cent); usually total number of leucocytes low; often marked leucopenia (1500 to 4000); but may be 20,000 to 100,000, or rise after initial leucopenia. Death always *within few days*, with terminal symptoms as above—i.e., is proof of greatly exhausted bone-marrow. Rarely observed, owing to short duration, and frequency unknown.

Diagnosis.—Usually simple. Enlargement of the spleen results in examination of the blood.

Treatment.—

GENERAL TREATMENT.—Good food, etc.

SPECIFIC TREATMENT, designed to reduce spleen and number of leucocytes.—Of most efficiency are: (1) X rays and radium; (2) Arsenic; (3) Benzol.

X RAYS.—Applied to spleen and long bones. Often cause great temporary reduction in leucocytes and spleen, and improved general condition, but duration is not prolonged. Radium less effective.

ARSENIC.—Similar but slighter action. May cause vomiting, also herpes.

BENZOL.—In capsules with olive oil. Commence with 5 minims of each twice a day: Results similar to X rays, but less effective.

DURING SPECIFIC TREATMENT: *Examine blood regularly;* always discontinue if number falls to 10,000 or 20,000 or myeloblasts increase considerably; if X-ray applications are continued, leucopenia or myeloblastic termination may develop

Splenectomy—Course of disease unaffected.

III. CHRONIC LYMPHOID LEUKÆMIA.

A fatal condition characterized by hypertrophy of lymphoid tissue in all sites and increase in the number of lymphocytes in the blood.

Etiology.—

AGE—Later decades: rare before 40 years

SEX—About 4 males to 1 female.

Morbid Anatomy.—Hypertrophy of lymphoid tissue throughout the body: may be large masses

LYMPHATIC GLANDS—Normal structure destroyed: germ centres not visible: masses of lymphocytes

SPLEEN, BONE-MARROW—Similar masses of lymphocytes. Also foci in liver

Symptoms.—Onset insidious. Recognition often by chance discovery of cervical glands or by increased lymphoid tissue elsewhere—e.g. enlarged tonsils, skin nodules, mediastinal glands, and thymus.

OTHER SYMPTOMS.—

Pruritus.

Bone-pains.

Impotence.

Spinal cord lesions: from pressure

LATE AND OCCASIONAL SYMPTOMS.—Cachexia. Anæmia. Hæmorrhages. Rarely Mikulicz's syndrome.

LYMPHATIC GLANDS.—Size moderate: discrete and painless.

SPLEEN.—Enlarged, but rarely below umbilicus.

SKIN.—May be red or discoloured from leucocytic infiltration (leukæmic erythrodermia).

Blood.—

LEUCOCYTES.—(1) Number: often 60,000 to 100,000 per c.mm., but may be very high or within normal limits: often vary rapidly. (2) Lymphocytes: 85 to 99 per cent (often over 95). Type: generally small cells with indented nucleus; rupture

Chronic Lymphoid Leukæmia—the Blood, continued.

readily in smears. May be a few lymphoblasts (bad prognosis) and myelocytes.

ERYTHROCYTES.—Anæmia develops late. Nucleated cells scanty.

BLOOD-PLATELETS.—Fall in late and hæmorrhagic states.

Varieties of Type.—

LARGE LYMPHOCYTES.—Rare and very chronic. Azur-granules scanty.

LEUCOPENIC OR ALEUKÆMIC TYPES.—Total leucocytes about normal or below: percentage of lymphocytes may be 30 per cent on first observation. Progress may be watched over months or years as total numbers, percentage of lymphocytes, and size of glands and spleen progress finally to typical state and death. This type is very rare, but occurs *at all ages*. (See also **ALEUKÆMIC LEUKÆMIA**, p. 739.)

Course.—Most chronic leukæmia. Often 2 or 3 years, but rarely may be up to 20 years. Death from exhaustion, intercurrent disease, or hæmorrhage. No acute lymphoblastic stage has been observed, but recognition of change from lymphocyte to lymphoblast would be difficult.

Diagnosis.—Rarely difficult, except in aleukæmic type.

Treatment.—X-ray application to glands and lymphoid masses; may reduce size and give comfort. Must not be applied to spleen, as reaction often serious.

IV. VARIOUS ATYPICAL FORMS AND CONDITIONS RESEMBLING LEUKÆMIA.

Many conditions occur in which changes in the hæmopoietic tissues and alterations in the blood are suggestive of, though varying in some degree from, leukæmia. Many groups occur, and each group has received many different names. Of most little is known. The following conditions may be noted:—

1. Growths in or of Hæmopoietic Tissues which are Neoplastic or Suggestive of Neoplasms.—Any growth in these tissues may alter the condition of the blood; thus, in glandular tuberculosis or lymphadenoma there is some leucopenia and relative lymphocytosis. More definite are:—

a. AFFECTIONS OF LYMPHOID TISSUE.—(i) True sarcoma, and various stages of less definite and ill-defined sarcomatous growths—e.g., 'lymphosarcoma,' 'lymphoma': some blood change is common—e.g., relative lymphocytosis, with leucopenia or sometimes leucocytosis (causing greater difficulty). (ii) At other end of scale is *chloroma* (see p. 740): blood typical of leukæmia, but glandular growths definitely *infiltrate other structures*—i.e., possess malignant characteristics. Mikulicz's

Atypical Forms and Conditions Resembling Leukæmia; *continued.*

6. **Various Conditions.**—In many blood disturbances, changes may occur at times resembling leukæmia ('*leukæmoid blood-pictures*'), including: (a) Extreme leucocytosis in septic infections: myelocytes and myeloblasts present. (b) 'Lymphotropic viruses', e.g., glandular fever (q.v.). (c) Erythræmia. (d) Tuberculosis (gold injections). (e) Leuco-erythroblastosis.

CHLOROMA.

A form of 'acute leukæmia' characterized by (1) Infiltration of subperiosteum and other tissues by the marrow-cells; (2) Predominance in skull bones; and (3) Green colour of growth on section.

Morbid Anatomy.—

SITES especially affected are: (1) Orbit; (2) Temporal bones; (3) Vertebrae; (4) Kidneys. Other bones, *especially skull*, also liable. Also *lymphatic glands* and skin.

TUMOURS are formed of masses of cells resembling those of acute myeloblastic leukæmia.

GREEN TINT may be very bright; fades on exposure to air; nature unknown. Not invariably present. Similar slighter tint may occur in acute myeloblastic leukæmia.

Symptoms.—Those of acute leukæmia, with certain local and pressure signs:—

1. OF ACUTE LEUKÆMIA.—Severe rapid anæmia, wasting, purpura, hæmorrhages, swelling of gums, vomiting, etc. *Spleen and lymphatic glands usually enlarged*, and may be greatly so.
2. PRESSURE SYMPTOMS.—Characteristic are: (a) *Protrusion of eyeballs* (from growth in orbit); (b) *Swellings in temporal region*; (c) *Blindness*. Often deafness.
3. TUMOURS FROM ENLARGED GLANDS.

Blood Changes.—As in acute myeloblastic leukæmia.

Prognosis and Duration.—Always fatal. Duration 3 to 6 months.

CHAPTER CXXXIV.

AGRANULOCYTOSIS.

A condition characterized pathologically by extreme leucopenia due mainly to diminution or absence of myeloid cells usually without anæmia, and clinically by tendency to ulceration of the mouth and other tissues. High mortality.

The ulceration and necrosis is secondary to the leucopenia.

Etiology.—Both sexes and all ages, but severe forms commonest in middle-aged women.

Causes.—(1) *Primary*: cause unknown. (2) *Secondary*, to: (a) amidopyrine, especially when given with barbiturates; (b) other drugs—e.g., dinitrophenol, gold; (c) septicæmia.

AMIDOPYRINE.—Accounts for 25 per cent of cases: may develop after single dose: only a few persons are susceptible.

Morbid Anatomy.—Sternal puncture of marrow shows either: (1) devoid of myeloblasts—i.e., aplasia for myeloid cells; or (2) numerous myeloblasts—i.e., hyperplasia but further development inhibited. No myelocytes or granular cells present. Erythropoietic tissues unaffected at onset.

Clinical Types.—Great variation in severity: (a) Fulminating; (b) Subacute; (c) Recurrent; (d) Mild.

a. FULMINATING TYPE.—Characteristics:—

1. Usually middle-aged women. Previously prolonged fatigue; insomnia common (amidopyrine may be taken). Leucopenia has sometimes been found previously.
2. Sudden onset. May follow slight stimulus, e.g., influenza. Pyrexia, rigor, malaise, sore throat, prostration. Occasionally slight jaundice. No purpura or hæmorrhages. Spleen rarely palpable.
3. Ulceration of mouth, fauces, and maybe elsewhere. May be œdematous swelling of neck and glands. In some cases, reddening of fauces only.
4. Rapidly fatal in few days.

b. SUBACUTE TYPE.—Similar to above, but angina and constitutional symptoms less severe. Anæmia, diminution of platelets, and hæmorrhages may develop. Fatal, or recovery in 6 or more weeks.

c. RECURRENT TYPE.—Causeless attacks over period of years, with normal intervals.

d. MILD TYPE.—Characteristics.—

1. Constitutional symptoms slight.
2. Inflammation of fauces moderate.
3. Occurs at all ages. May be previous record of neutropenia.
4. Recovery complete and uneventful.

Blood Changes.—

LEUCOCYTES.—(a) Total number: extreme leucopenia, may be few hundreds only. (b) Granulocytes practically absent.

RED CELLS, HÆMOGLOBIN, AND PLATELETS—Often little affected, but in severe cases advanced anæmia may develop (rapidly fatal).

Diagnosis.—May be indistinguishable from acute leukæmia with leucopenia (aleukæmic leukæmia), especially monocytic, and from severe hæmorrhagic diathesis. The mild type may resemble glandular fever. Diagnosis from Vincent's angina, diphtheria, etc., by blood and throat swabs.

Treatment.—

NUCLEIN DERIVATIVES.—E.g., pentnucleotide K. 36. Dosage: up to 50 c.c. daily intramuscularly. Effective in certain cases, but knowledge incomplete. Response immediate or within 4 days.

BLOOD TRANSFUSION.—Serious reactions may follow. Value not yet known.

IN AMIDOPYRINE CASES.—Recovery may follow withdrawal. Little response to pentnucleotide. Amidopyrine must *never* be taken again: sensitivity prolonged.

CHAPTER CXXXV.

LEUCO-ERYTHROBLASTOSIS.

A fatal condition characterized by the presence in circulating blood of immature red cells and immature myeloid white cells, usually but not always associated with various diseases of bone or bone-marrow.

Synonyms.—Myelophthisic anæmia. Leukanæmia. Leuco-erythroblastic anæmia: this title over-emphasizes anæmia.

Pathogenesis.—The blood contains immature red and immature myeloid cells, indicating disturbance of normal stages of formation; viz., dyshæmopoiesis, often attributed to 'irritation' of bone-marrow by foreign tissue. Reduction of marrow would not explain blood changes: marrow existing is usually hyperplastic. Has occurred in association with various conditions:—

1. Carcinomatosis of bone.
2. Albers-Schönberg's marble-bone disease.
3. Multiple myeloma.
4. Myelosclerosis.
5. Cooley's erythroblastic anæmia.
6. Various conditions which in rare cases involve bones: e.g.,¹ miliary tuberculosis, Hodgkin's disease, syphilis.
7. No associated lesion discovered.

Similar 'irritation' may account for rare abnormal blood changes in leukaemia ('mixed leukaemia', changes of type), and in pernicious anæmia (myeloid changes).

Morbid Anatomy.—

BONE-MARROW.—Usually but not invariably hyperplastic.

SPLEEN.—Enlarged: myeloid metaplasia.

LIVER.—Similar but less marked changes.

Blood Changes.—

1. **RED CELLS.**—Anæmia variable: not always severe. Size normal. Immature cells, especially basophilic erythroblasts; also nucleated reds may be numerous. Colour index at or below normal.
 2. **LEUCOCYTES.**—Normal or, more commonly, increased: rarely over 50,000. Myelocytes present and may be myeloblasts.
 3. **PLATELETS** reduced.
- Van den Bergh's reaction: negative.

Clinical Manifestations.—No constant characteristics. Exhaustion, symptoms of anæmia, splenomegaly (moderate to extreme). Causal condition often initial feature. Always fatal in 2 to 5, or rarely 10, years. Death from causal condition, anæmia, or with manifestations of hæmorrhagic diathesis.

CARCINOMATOSIS OF BONE.

Carcinoma of bone is secondary. Primary growth commonly in : breast, stomach, lungs ; also thyroid, prostate (these latter have special tendency to bone metastases). Primary growth often small.

Effect of Secondary Growths, on :—

1. BONE.—Stimulates changes, either :—
 - a. Osteoclastic resorption. Hence cortex thin, fractures common, calcium output high.
 - b. Osteoblastic apposition. Hence cortex thick and dense, fractures unusual, calcium output low.
(Calcium metabolism may be normal).
2. BONE-MARROW.—Around growths, is hyperplastic, with increase of megaloblasts and myeloblasts.

Clinical Features.—

1. Pains in bones.
2. Fractures.
3. Anæmia : various changes (*see* LEUCO-ERYTHROBLASTOSIS, p. 742).
4. Radiographs : scattered pale areas in bones.

ALBERS-SCHONBERG'S MARBLE-BONE DISEASE.

(*Osteopetrosis. Osteosclerosis.*)

A defect commencing in intra-uterine life resulting in excessive bone formation. Possibly a primary dyscrasia of the mesenchyme. No evidence of hyperparathyroidism. No treatment effective.

Etiology.—Congenital : may be hereditary. Both sexes affected.

Bone-changes.—Skull, vertebræ, and long bones mainly affected. Contour unaltered, but ends of long bones may be clubbed. Cortex thickens : dense bone. Marrow cavity narrowed, may be almost obliterated : marrow hyperplastic.

RADIOGRAPHS.—Dense areas, especially middle third of shafts and base of skull.

Symptoms.—

BACKWARDNESS.—Usually earliest symptom : due to hydrocephalus.

COMPRESSION OF CRANIAL NERVES BY BONE.—Blindness, etc.

FRACTURES.—Due to rigidity of bone.

ANÆMIA.—*See* LEUCO-ERYTHROBLASTOSIS, p. 742.

SPLENOMEGALY.—Liver may be enlarged.

Calcinosis of soft tissues has been recorded.

Local Type (Melorheostosis Leri).—May be one or more bones. Excrescences on contour. May be friable.

MULTIPLE MYELOMA.*(Kahler's Disease.)*

The presence of multiple primary tumours in bones, often associated with anæmia and excretion of Bence Jones' protein in the urine. Occurs in later decades; more common in males.

Morbid Anatomy.—Skull, vertebræ, ribs, and pelvis especially affected. Multiple tumours sharply defined, may form large masses; cortex thinned. Cells appear to arise from marrow, but vary: myeloid cells or often plasma cells. May be masses in tonsils and other organs: said to precede bones occasionally.

Symptoms.—

1. PAIN.—Vague in back and bones. Compression myelitis or neuritis.
2. BONES.—Swellings, deformities, and fractures.
3. BLOOD.—*Anæmia*, usually microcytic. *Leucocytes*: 10,000 to 15,000; few myelocytes. Few cells of growth present. Occasionally leuco-erythroblastosis.
4. BENCE JONES' PROTEIN IN URINE.—Not normally formed in body. Large amounts excreted in urine (70 gm. daily). Precipitates at 50° to 56° C: dissolves on further heating; reappears on cooling. Not always present. *Protein in blood high*: chronic nephritis may develop with albuminuria.
Note—The protein was formerly erroneously believed to be albumose and the condition was called Bence Jones' albumosuria.
5. RADIOGRAPHS.—Cortex thin and 'moth-eaten'. Calcium excretion high. Metastatic calcification recorded.

Diagnosis.—By radiographs and sternal puncture.

Course.—X rays may ease pain. Death in 2 years.

MYELOSCLEROSIS.*(Osteosclerosis.)***Characteristics.**—

1. Onset in adult life.
2. BONE CHANGES.—Is a dystrophy of bone. Excess of bone or fibrous tissue in spongiosa and medullary cavity. No changes in cortex; no tendency to fractures. Marrow reduced, hyperplastic or aplastic. Radiographs: indecisive.
3. BLOOD CHANGES.—Anæmia may be severe; leucocytes rarely increased, few myelocytes. Blood may be leuco-erythroblastic.
4. SPLEEN.—Often enlarged.

Diagnosis.—May be difficult from leukæmia.

Treatment.—Blood transfusion. Iron and liver useless.

ERYTHROBLASTIC ANÆMIA OF COOLEY.

A fatal disease commencing from birth characterized by changes in the blood, and usually associated with abnormal bone formation.

Etiology.—Almost confined to Mediterranean races. Congenital but not always hereditary. Symptoms appear between 6 months and 3 years.

Morbid Anatomy.—True bone partly replaced by fibrous tissue (as in osteitis fibrosa): trabeculæ thinned. Marrow hyperplastic; numerous megaloblasts, few red cells.

Clinical Features.—

1. **MONGOLIAN FACIES.**—Due to muddy skin and thickened malar eminences. Pigmentation due to hæmosiderin deposition.
2. **BONE CHANGES.**—Deformities Fractures uncommon.
3. **BLOOD CHANGES.**—*Anæmia*: may be severe, numerous immature red cells ('erythroblasts', few megaloblasts). Anisocytosis. Colour index low. *Leucocytes*: increased, few myelocytes Platelets and fragility normal. Van den Bergh: indirect positive.
4. **SPLENOMEGALY.**—
Liver palpable: glands rarely.

Course.—No treatment Death in childhood: rarely over 10 years.

Diagnosis.—From von Jaksch's anæmia, rickets, nutritional anæmia, acholuric jaundice

CHAPTER CXXXVI.**ENTEROGENOUS CYANOSIS.**

(*Methæmoglobinæmia. Sulphæmoglobinæmia.*)

A chronic condition of cyanosis without cardiac or pulmonary lesions, due to presence of abnormal hæmoglobin compounds.

Drugs Producing Cyanosis.—Abnormal cyanotic tints can result from: (1) *Potassium chlorate* (also causes hæmolysis); (2) Certain coal-tar preparations—phenacetin, acetanilide, sulphonal, trional, sulphanilamide, and also plasmogone.

The altered hæmoglobin in these cases may be (1) methæmoglobin, or (2) sulphæmoglobin: the pigment is usually entirely *intra-corporcular*, no hæmolysis occurring, and the pigment is *absent from the serum and the urine*. The percentage of hæmoglobin affected may be small, and hence *no dyspnœa* present; but attacks of severe dyspnœa may occur.

In methæmoglobinæmia, drug acts directly on the red cells. In sulphæmoglobinæmia, drug injures red cells, which then absorb H_2S from bowel, constipation being necessary.

Note.—Sulphæmoglobinæmia is produced by H_2S only experimentally: thus workers in sewers exposed to H_2S never show it.

Enterogenous Cyanosis, *continued*.

Tests for Pigments in Blood.—Spectroscopic. Both varieties show a band between C and D, distinguishable: (1) By accurate measurements of position of line; (2) By gradual addition of ammonium sulphide: methæmoglobin is rapidly changed to hæmoglobin, sulphæmoglobin is unchanged (except by strong solutions).

Symptoms.—Nervousness, headache, weakness, and psychical disturbances. Lead-blue colour of lips and skin. Patient appears *in extremis*, but no dyspnœa or serious symptoms. Some polycythæmia. Constipation in sulphæmoglobinæmia.

Diagnosis.—Cyanosis from other causes, e.g., heart disease. A few non-drug cases recorded: may be due to intestinal organisms, but deception possible. Drug-taking often concealed.

Treatment.—Withdrawal of drug sufficient.

CHAPTER CXXXVII.

BLOOD DISEASES OF INFANCY AND CHILDHOOD.

Classification.—

1. HÆMOLYTIC ANÆMIAS OF THE NEWBORN.—(1) Icterus gravis neonatorum; (2) Congenital anæmia of the newborn.

WINCKEL'S DISEASE (*Epidemic Hæmoglobinuria*).—May occur as epidemic in institutions: probably hæmolytic streptococcus or colon bacillus. Hæmorrhages, icterus, anæmia, and hæmoglobinuria. Spóradic cases occur.

2. HÆMORRHAGIC ANÆMIAS OF THE NEWBORN.—Melæna neonatorum. Also: syphilis, sepsis.

3. NUTRITIONAL ANÆMIA OF INFANCY (dyshæmopoietic).—Age: later lactation to 3 years. Simple microcytic anæmia. Mainly due to excessive milk diet, poor in iron, in constitutionally frail children.

TREATMENT.—Diet and iron (ferri et amm. citratis: gr. 5 to 10 daily).

Anæmia of prematurity and of over-lactation are similar iron-deficiencies.

4. VITAMIN AND ENDOCRINE DEFICIENCY.—(1) Rickets; (2) Scurvy; (3) Cœliac disease; (4) Hypothyroidism (yields to thyroid).
5. VARIOUS.—(a) Syphilis: anæmia, hæmorrhages, jaundice and splenomegaly of many types and grades. (b) Banti's disease. (c) Von Jaksch's anæmia. (d) Cooley's anæmia.
6. COMMON TO ADULTS.—(a) Acholuric jaundice; (b) Lederer's anæmia; (c) Aplastic anæmia (anæmia gravis); (d) Hæmorrhagic diathesis; (e) Hæmophilia; (f) Leukæmia; (g) Malaria

and tropical infections; (h) Symptomatic and secondary anæmia. In children anæmia and sepsis produces varied blood-pictures.

Transient causes of lymphocytosis: Whooping-cough, glandular fever or infective mononucleosis, and other lymphotropic viruses.

See LEUCOCYTOSIS, p. 728.

Splenomegaly in Childhood.—Of above conditions, definite splenomegaly occurs in rickets, syphilis, leukæmia, acholuric jaundice, von Jaksch's anæmia, Banti's disease, and hæmolytic anæmias. May or may not be enlarged in group of hæmorrhagic diathesis and all chronic anæmias. Also enlarged in congenital obliteration of bile-ducts and in various causes of enlargement in adults, e.g., specific fevers. (See also SPLENOMEGALY, p. 754.)

TRAUMATIC HÆMORRHAGES IN THE NEWBORN.

Due to injury at birth. Important after-effects.

Varieties.—

- a. CEPHALHÆMATOMA.—Blood between bone and periosteum. Absorbed slowly. Of little importance unless simultaneous internal hæmorrhage.
- b. MENINGEAL HÆMORRHAGE.—Usually bilateral. May be fatal. Probably a cause of porencephaly. After-effects: Spastic paraplegia (Little's disease), idiocy, etc.
- c. STERNOMASTOID.—After-effects: Congenital torticollis.

HÆMOLYTIC ANÆMIAS OF THE NEWBORN.

A group of hereditary conditions, with an unknown common basis, which become manifest in the newborn. Mutual connection is proved by the various types developing in successive children of the same mother: first-born usually escapes. Mother may develop jaundice in later stages of pregnancy.

The group includes: (1) Congenital hydrops; (2) Icterus gravis neonatorum; (3) Congenital anæmia of the newborn.

Uncertain if condition is hæmolytic (as here classified), or error of blood formation, dyshæmopoietic. Is not syphilitic.

Features common to group are: (1) Parturition normal. (2) Vernix caseosa is bright yellow. (3) Blood: numerous nucleated red cells and immature forms or erythroblasts, whence occasional title 'erythroblastæmia foetalis'. (4) Spleen and liver greatly enlarged and contain free iron. Extra-medullary hæmopoiesis. (5) Degeneration of basal nuclei common (cf. Wilson's disease).

Congenital Hydrops.—

CHARACTERISTICS.—Stillborn, or death within a few hours. Placenta large and cedematous. Body dropsical. Blood anæmic. Rare.

Hæmolytic Anæmias of the Newborn, continued.

Icterus Gravis Neonatorum.—

CHARACTERISTICS.—Jaundice appears within few hours; at onset resembles physiological jaundice. Anæmia: severe, many nucleated red cells and erythroblasts; reticulocytes increased; leucocytes increased, may be myelocytes. Van den Bergh's reaction: indirect positive. *Spleen and liver* greatly enlarged. Symptoms advance rapidly if untreated. Mortality 50 to 80 per cent. May be spontaneous recovery. Death in few days to weeks.

TREATMENT.—Urgent. Serum or whole blood, 5 to 10 c.c.: daily intramuscular injections. Alternatively, blood transfusion, 30 to 50 c.c. Continue until anæmia improves. Not invariably effective.

SEQUELÆ.—In cured or recovered cases, extra-pyramidal lesions may develop, spasticity, athetosis, or mental defects.

Congenital Anæmia of the Newborn.—

CHARACTERISTICS.—Anæmia becomes apparent at end of first week up to two months or more. Jaundice slight or absent. Blood changes, general features, treatment, and sequelæ as above. Recovery usual if onset later than first week. Later and milder forms merge into picture of von Jaksch's anæmia (but not necessarily identical).

Diagnosis.—Familial history, yellow vernix caseosa, erythroblastæmia and enlarged spleen distinguish from physiological jaundice, infective jaundice, congenital obliteration of bile-ducts, syphilis (Wassermann reaction should be performed), and melæna neonatorum.

MELÆNA NEONATORUM.

A transient hæmorrhagic state of the newborn. Is not related to icterus gravis neonatorum.

Etiology.—Birth normal. Infant healthy. No heredity.

Pathogenesis.—Unknown; probably deficiency of some clotting factor; is not hæmophilia, hæmolytic, or hæmorrhagic diathesis. Peptic ulcers found at autopsy are necrosed areas.

Symptoms.—Onset sudden and spontaneous. Usually first to fifth days, rare after seventh. Hæmorrhage generally from bowels, but no site or organ immune. *Blood*: platelets normal; coagulation and bleeding time prolonged.

Course.—Often stops spontaneously. *Mortality* (including treated cases): 10 per cent. Course is rapid and treatment must be immediate.

Treatment.—*Intramuscular injections of whole blood*: 10 c.c.; repeat twice daily until hæmorrhage stops (usually two injections); no typing necessary; very effective. Blood transfusion if anæmic. Can be fed shortly. No subsequent tendency to hæmorrhages.

Other Causes of Hæmorrhage.—Syphilis, sepsis.

VON JAKSCH'S ANÆMIA.

(*Anæmia Pseudoleukæmica Infantum.. Splenic Anæmia of Infancy.*)

A disease of infants characterized by severe anæmia, leucocytosis, and splenomegaly. Now rare.

Etiology.—

AGE.—Between 6 months and 2 years. Not over 4 years.

PREDISPOSING FACTORS.—Not hereditary. Mainly in poor children, especially bottle-fed. Rickets and syphilis common, but both may be absent.

Pathogenesis.—Uncertain. Disputed as an entity: not observed to develop from secondary anæmia. May be extreme or prolonged reaction to various nutritional and vitamin defects, congenital hæmolytic anæmia, or infections; also to rickets, and syphilis.

Morbid Anatomy.—Not distinctive. Spleen capsule may be thickened. Bone-marrow aplastic.

Symptoms.—

ONSET.—Insidious: usually well developed but flabby and anæmic. General weakness. Abdomen protuberant. Digestive disturbances. Occasional purpuric spots, but hæmorrhages except epistaxis rare. No jaundice. Lymphatic glands may be slightly enlarged.

SPLEEN.—Enlarged, often to umbilicus.

LIVER.—Moderate enlargement.

BLOOD CHANGES.—

1. ERYTHROCYTES.—Extreme anæmia: under 2,000,000: hæmoglobin 10 to 40 per cent. Colour index low. Nucleated red cells and erythroblasts numerous, also reticulocytes.

2. LEUCOCYTES.—Increased, 20,000 to 40,000 per c.mm., or more. Myelocytes present, may be 10 to 25 per cent. Leucopenia is recorded.

3. PLATELETS.—Vary: often increased.

Progress.—Majority recover on correct treatment. Fatalities from: (1) Intercurrent diseases. (2) Extreme anæmia on first observation; termination by exhaustion or with hæmorrhages.

Treatment.—Iron, liver, vitamins; balanced diet. Blood transfusion if anæmia severe. Splenectomy contra-indicated.

CHAPTER CXXXVIII.

SPLENIC ANÆMIA AND BANTT'S DISEASE.

A chronic disease of unknown origin, characterized by enlargement of the spleen without increase of the lymphatic glands, by microcytic anæmia and leucopenia, a tendency to recurrent hæmorrhages, and, in the later stages of certain types, cirrhosis of the liver.

This definition corresponds to Banti's original description in 1894, and must only be accepted in conjunction with the following paragraphs. Splenic anæmia in adults had been described previously.

Splenic Anæmia and Banti's Disease, continued.

Original group included in such definition contained several distinct diseases. Note:—

1. Diseases separated since Banti's description:—

- a. Kala-azar: 'infantile splenic anæmia'.
- b. Gaucher's disease: and lipoid histiocytosis.
- c. Egyptian splenomegaly or Egyptian Banti's disease, due to schistosomiasis.
- d. Syphilis (rare).
- e. Thrombosis of portal and splenic veins.

2. *Splenic Anæmia of Adults and Banti's Syndrome*.—These are separate entities: confused by Banti originally terming his syndrome 'splenic anæmia'. Principal distinctions:—

Banti's Disease.—Onset in later childhood. Progresses to cirrhosis of liver. Duration about 5 years.

Splenic Anæmia of Adults.—Onset usually in early decades of adult life. Associated with severe anæmia; tendency to hæmorrhages. Does not progress to cirrhosis of liver. Duration often 10 to 20 years.

3. The group merges into various other groups, e.g., some obscure liver-spleen diseases with varying degrees of icterus and hæmorrhages, and some manifestations of the hæmorrhagic diathesis.

4. *Splenic Anæmia of Adults and Hæmorrhagic Diathesis*.—

Note.—(a) Clinical resemblance to more chronic hæmorrhagic diathesis is so close that purpuric spots would change diagnosis (hence statement that purpura does not occur in splenic anæmia). (b) Hæmorrhage other than hæmatemesis may occur in splenic anæmia and cannot be attributed directly to spleen kinking vessels. (c) Blood changes are similar: platelets usually reduced, no jaundice, marrow often hypoplastic.

Conclusions.—Certain cases of splenic anæmia of adults belong to the hæmorrhagic diathesis.

Many obscure cases occur which cannot be placed satisfactorily in any recognized group.

Two groups will be described here, viz.: (I) Splenic anæmia of adults; and (II) Banti's disease; these undoubtedly are distinct from each other.

Pathogenesis.—Unknown. Theories are purely hypotheses, based mainly on following features: (1) Splenomegaly is assumed to be earliest symptom; (2) Early splenectomy may cure (hence assumed that spleen is a pathogenetic factor); (3) Phlebitis of splenic vein common; (4) Anæmia may precede hæmorrhages; (5) Signs of regenerating bone-marrow absent, e.g., no nucleated red cells (only evidence of hæmolysis is increased urobilin); (6) In Banti's disease, spleen enlarges before liver is affected (against an intestinal toxin). Theories include:—

a. **PRIMARY DISEASE OF SPLEEN**.—An inflammatory process causing greater activity in blood destruction.

b. PRIMARY PHLEBITIS OF SPLENIC VEINS.—Based on fact that phlebitis of splenic or portal veins produces a similar condition.

c. STREPTOTHRIX INFECTION.—Not impossible for some cases. Each observer has different organism.

CAUSE OF HÆMATEMESIS.—Has been ascribed to enlarged spleen kinking veins from stomach, and to hæmorrhagic diathesis.

I. SPLENIC ANÆMIA OF ADULTS.

Etiology.—

SEX.—Males commoner.

AGE.—Onset in earlier decades of adult-life : but also in children. Rarely hereditary or familial factors. Not syphilitic.

Morbid Anatomy.—

1. SPLEEN.—Very large ; firm, thick capsule ; infarcts common. *Histology* : diffuse fibrosis, sinuses dilated and filled with blood

2. SPLENIC VEINS.—Phlebitis and some obstruction common. Portal vein may be similarly affected. Dilatation of œsophageal and other veins distal to obstruction.

BONE-MARROW.—Usually hypoplasia.

LIVER.—No cirrhosis.

LYMPHATIC GLANDS.—No distinctive change.

Symptoms.—*Onset* : (a) Insidious anæmia ; or (b) Sudden hæmorrhage.

1. ENLARGEMENT OF SPLEEN.—To umbilicus or below ; smooth and painless. Present at onset of symptoms.

2. ANÆMIA.—Slow advance : finally extreme. Rarely rapid. May develop without hæmorrhages.

3. HÆMATEMESIS.—May recur for years, with irregular and prolonged intervals. Often profuse. May be fatal. Epistaxis, hæmaturia, and other hæmorrhages rarely occur.

BLOOD CHANGES.—

a. ERYTHROCYTES.—Microcytic anæmia : often 3 to $3\frac{1}{2}$ millions, with 30 to 50 per cent hæmoglobin.

b. LEUCOCYTES.—Leucopenia marked (1000 to 3000 per c.mm.) ; relative lymphocytosis.

c. BLOOD-PLATELETS.—Normal : or often moderate reduction. Abnormal red and white cells rare. Reticulocytes, bleeding time, coagulation time, and gastric acidity normal.

Indefinite gastro-intestinal disturbances common. No jaundice.

Course.—Prolonged. With occasional hæmorrhages, may be 20 years. Never cirrhosis of liver.

Death from : (1) Anæmia ; (2) Hæmorrhage ; (3) Intercurrent disease.

Diagnosis.—From :—

HÆMORRHAGIC DIATHESSES.

GASTRIC ULCER.

VARIOUS CONDITIONS ASSOCIATED WITH SPLENOMEGALY.—Syphilis. Tuberculosis. Cirrhosis of liver.

Splenic Anæmia of Adults—Diagnosis, *continued*.

LEUKÆMIA (blood examination). LYMPHADENOMA (glandular enlargement).

PERNICIOUS ANÆMIA.—Spleen rarely more than palpable: anæmia of primary type.

SUBACUTE BACTERIAL ENDOCARDITIS.

TROPICAL SPLENOMEGALY, KALA-AZAR, MALARIA.

Rare diseases:—

ACHOLURIC JAUNDICE.

GAUCHER'S DISEASE. LIPOID HISTIOCYTOSIS.

THROMBOSIS OR PHLEBITIS OF PORTAL OR SPLENIC VEINS.—Great enlargement of spleen; ascites may occur.

Treatment.—

IRON.—In massive doses: causes considerable improvement in absence of repeated hæmatemesis.

SPLENECTOMY.—In cases of sufficient severity, especially with repeated hæmatemesis (and with diminished platelets). Hæmorrhages may cease subsequently, but recur in some cases. If spleen large, irradiation may reduce size. Many good results, but complete cure rare. Preliminary blood transfusion.

II. BANTI'S DISEASE.

Etiology.—

AGE.—Onset in later childhood or adolescence.

No hereditary or familial factors.

Morbid Anatomy.—

LIVER.—Contracted. Interlobular cirrhosis present.

Note.—Banti described minutely special histological changes in the spleen which he found in cases of his clinical syndrome. Cases clearly identical clinically with those in which Banti recognized his syndrome are not infrequent, but Banti declined to accept them in absence of his pathological changes, which are practically never found. Banti's pathology has caused much trouble, and should not be too strictly accepted.

Symptoms.—Onset with anæmia and splenomegaly. Anæmia moderate. No glands or jaundice. After 1 to 3 years jaundice commences: liver enlarges. In last stage, symptoms of cirrhosis of liver with ascites, gradual wasting, etc. Jaundice usually only icteroid tinge, but may be deeper. Termination as in cirrhosis of the liver: liver not greatly enlarged. No special tendency to hæmorrhages. Duration 3 to 5 years.

Diagnosis.—*Early stage:* See SPLENIC ANÆMIA OF ADULTS. *Ascitic stage:* Tuberculous peritonitis; neoplasms; cirrhosis of the liver.

CIRRHOSIS OF THE LIVER with splenomegaly.—Resemblance may be close.

1. ALCOHOLIC CIRRHOSIS.—With hæmatemesis, ascites, and occasionally enlarged spleen. History often distinguishes

2. **SYPHILITIC CIRRHOSIS.**—Spleen often very large, and similar symptoms. Wassermann reaction positive; liver nodular and other signs of syphilis.

3. **HANOT'S HYPERTROPHIC CIRRHOSIS.**—Liver enlarged.

Course and Prognosis.—Always fatal before adult life.

Treatment.—

SPLENECTOMY.—Transient improvement: partial only. Contra-indicated if evidence of cirrhosis present.

IRON.—Effect slight.

CHAPTER CXXXIX.

DISEASES OF THE SPLEEN.

I. FUNCTIONS OF THE SPLEEN.

In the Fœtus, the spleen forms red blood-cells.

During Life, the functions are :—

1. Hæmolysis, i.e., destruction of red cells. Storage of blood.
2. Formation of lymphocytes.
3. An unknown response to infections, probably defensive.
4. Metabolism of fats, lipoids, iron, etc., in cells of reticulo-endothelial system.

May supply hormone to bone-marrow, stimulating replacement of destroyed cells; hence anæmia after splenectomy.

Splenectomy.—Removal of normal spleen is not followed by any serious sequelæ. Results :—

1. Polynuclear leucocytosis (20,000 to 40,000) : immediately after operation : fever usual, suggesting sepsis. Gradual decrease to normal in many months : may be relative lymphocytosis.
2. Anæmia. Mild degree. Recovery slow.
3. Increased resistance of red cells to hæmolysis.
4. Blood-platelets increase twice or three times in few days; then gradually fall to previous number.
5. Enlargement of hæmolymp (prevertebral) glands.

In dogs : lessened tendency to jaundice and hæmoglobinuria.

Similar changes follow removal of many abnormal spleens.

--INDICATIONS FOR SPLENECTOMY.—Splenic anæmia and Banti's disease. Acholuric jaundice. Hæmorrhagic diathesis.

CONTRA-INDICATIONS TO SPLENECTOMY.—Leukæmia.

Syphilis. Malaria. Tuberculosis. Erythræmia. Thrombosis of portal and splenic vein. Lipoidosis. Pernicious anæmia.

NOTE.—Normal platelet count in general is contra-indication. Following splenectomy, platelets may rise very high, and incidence of thrombosis is considerable.

II. ENLARGEMENT OF SPLEEN: SPLENOMEGALY.

Enlargement of the Spleen occurs with—

1. DISEASES OF THE BLOOD.*—(a) Leukæmia; (b) Splenic anæmia and Banti's disease; (c) Pernicious and aplastic anæmia; (d) Erythræmia; (e) Acholuric family jaundice; (f) Von Jaksch's anæmia; (g) Hodgkin's disease; (h) Hæmorrhagic diathesis (inconstant).
NOTE.—Spleen may be enlarged in *any chronic anæmia*.
2. BACTERIAL AND SPECIFIC INFECTIONS.—(a) Sepsis—e.g., septicæmia; (b) Specific fevers.
3. CONDITIONS ASSOCIATED WITH HEPATIC CIRRHOSIS.
4. PROTOZOAL AND TROPICAL INFECTIONS.—Malaria, kala-azar, trypanosomiasis, schistosomiasis (Egyptian splenomegaly).
5. TUBERCULOSIS.
6. SYPHILIS.
7. RICKETS.
8. VASCULAR LESIONS.—(a) Infarcts; (b) Embolism and thrombosis of splenic vessels; (c) Cardiac failure.
9. TUMOURS AND CYSTS—Rare.
10. LIPOIDOSES. HÆMOCHROMATOSIS.
11. AMYLOID DISEASE.

Great Enlargement.—Common causes are: (1) Chronic leukæmia; (2) Splenic anæmia; (3) Syphilis; (4) Malaria; (5) Kala-azar. Rare diseases with great enlargement: Erythræmia, Hanot's cirrhosis, hæmochromatosis, Gaucher's type.

III. MOVABLE SPLEEN.

Rare condition. Marked general enteroptosis usually present: but movable spleen is not found in more than 2 per cent of such cases. Rarely occurs alone. Mobility sometimes extreme. Usually some enlargement. Adhesions subsequently may fix organ.

Symptoms.—None associated specially with spleen; sometimes dragging pain. Very rarely: torsion of pedicle, with acute abdominal pain.

Treatment.—(1) Belt and pad. (2) Fixation by operation: satisfactory if other organs in place.

IV. RUPTURE OF SPLEEN.

Occurrence.—(1) Normal spleen: severe trauma necessary. (2) Malarial spleen: following a blow; *very rarely* spontaneously. Similarly in other enlargements. (3) Infarcts of spleen, very rarely.

Hæmorrhage, without rupture, may follow puncture enlarged spleen.

Symptoms.—(1) Sudden pain; followed by symptoms of (2) Internal hæmorrhage; and (3) Fluid in peritoneum.

Treatment.—Laparotomy, and removal of spleen.

* Some included here are not primary blood diseases.

V. INFARCTS, NEOPLASMS, AND CYSTS OF THE SPLEEN.

Infarcts.—Spleen is most common site next to kidneys.

ORIGIN.—(1) Emboli in splenic arteries : (a) Simple—endocarditis, cardiac thrombi ; (b) Infective—infective endocarditis, sepsis. (2) Thrombus formation—e.g., in typhoid.

MORBID ANATOMY.—Either red or white infarcts. Usually multiple. Size, $\frac{1}{4}$ to 3 inches.

SYMPTOMS.—Pain and tenderness in left hypochondrium. Spleen may be palpable. Occasionally friction sound. Fever.

Tuberculosis.—Very common ; secondary to infection elsewhere.

Neoplasms and Gummata.—Very rare.

Cysts.—Hydatid is most common Others very rare.

CHAPTER CXL.

HODGKIN'S DISEASE.

(*Lymphadenoma.*)

A fatal disease involving lymphoid tissue, characterized by enlargement of the lymphatic glands and progressive anæmia, usually with enlargement of the spleen.

Etiology.—

AGE.—Commonest in young adults.

SEX.—Proportion of 2 males to 1 female.

No hereditary factor.

Pathogenesis.—Uncertain. Lymphadenoma cells probably arise from reticulo-endothelium, and condition may be reticulo-endotheliosis. Has been considered to be a *granuloma*, the result of a chronic inflammation. Is not a bacterial disease, but tuberculosis may coexist. Transmission to animals fails.

GORDON'S TEST.—Intracerebral inoculation of rabbit with specially prepared suspension of lymphadenoma gland substance causes paralysis and ataxia (75 per cent), and often death, from encephalitis. 'Elementary bodies', resembling Paschen's, also described : sensitized vaccine being tried. Confirmation of these results and their specificity awaited.

Morbid Anatomy.—*Initial change* is hyperplasia of lymphoid tissue and reticulum indistinguishable from acute or subacute inflammatory processes, and at such stage is not diagnostic. The characteristic change results in enlargement of the lymphatic glands and lymphoid tissue. May be enormous masses, but the nodules are discrete, united by connective tissue, rupture of the capsule being rare. *Periadentitis* may follow secondary infection or as result of X rays.

Hodgkin's Disease—Morbidity Anatomy, *continued*.

1. LYMPHATIC GLANDS.—

DISTRIBUTION OF AFFECTION AND ENLARGEMENT.—(a) *Superficial glands* commonly affected first—most often cervical; at onset may be unilateral. (b) Glands of axilla and groins usually enlarge next. (c) Internal glands; when these are affected together with the superficial glands, enlargement is usually in order from above downward, e.g., mediastinal before abdominal; in some cases the internal glands alone are affected. (d) Lymphoid tissue in all sites may be affected, e.g., in intestinal canal.

ON SECTION.—Gray surface, translucent appearance, often lobulated by strands of connective tissue; there may be yellow areas of fatty degeneration, but without caseation.

HISTOLOGY.—Changes pathognomonic, and form only definite method of diagnosis: (a) *Giant cells* with 3 or 4 nuclei near centre of cell ('lymphadenoma cells'); (b) Great increase of endothelial cells having large single nuclei; (c) *Eosinophils* may be in large numbers and masses; (d) In the later stages great increase of fibrous tissue.

2. SPLEEN.—Always enlarged to some extent, but rarely extreme.

ON SECTION.—Contains gray areas about the size of a walnut, histologically resembling the structure of the abnormal lymphatic glands ('hard-bake spleen').

3. LIVER.—Often enlarged; may be nodules like those in spleen. (

4. KIDNEYS.—Occasionally contain nodules.

5. BONE-MARROW.—Infiltrated with similar lymphoid tissue.

6. VERTEBRAL CANAL.—Cord or nerve roots may be compressed by growth.

All lymphoid tissue may be similarly affected.

Blood Changes.—No diagnostic features.

1. ERYTHROCYTES.—Progressive secondary anaemia; reduction in red cells and haemoglobin, and lowered colour index. Changes often slight in early stages, but finally severe.

2. LEUCOCYTES.—There may be either: (a) Leucopenia, with a relative lymphocytosis: commonly. (b) Leucocytosis, with an increase of polynuclear cells: especially in terminal stages. *Eosinophils* may be increased, rarely exceeding 10 per cent.

Similar changes (except eosinophilia) occur in glandular tuberculosis and certain other causes of general lymphatic enlargement, and are not diagnostic.

Rare: changes of leuco-erythroblastosis.

Symptoms.—

ONSET.—Insidious.

EARLIEST SYMPTOM.—Usually enlargement of glands, especially cervical; painless; size attracts attention.

PALLOR, ANAEMIA, and WEAKNESS.—Slight in early stages; slowly increase. No tendency to hæmorrhages.

SPLEEN.—Usually palpable (75 per cent), a few finger-breadths ; edge hard and sharp. Marked **LIVER** increase unusual.

FEVER.—Usual ; slight and irregular (*see also* **PEL-EBSTEIN SYNDROME**, p. 758).

SKIN.—Occasionally : pruritus (may be severe) ; café-au-lait tint or general or local pigmentation. Rarely : superficial nodules.

ENLARGEMENT OF GLANDS.—

CHARACTER.—*Glands discrete*, freely movable (until mass very large), *never adherent to, and no reddening of, skin* ; no ulceration or caseation. Glands soft when growth rapid, firm and hard when slow.

Note.—*Periadenitis* from secondary infection or X rays may cause glands to become adherent.

DISTRIBUTION (*see* **MORBID ANATOMY**).—At onset there is always one mass larger than the others. Commonly commences in posterior triangle of neck. Finally may affect all lymphoid tissue and produce enormous masses.

Scattered lymphoid tissue which may be affected includes :

- (1) Glands over sternum and below clavicles : common.
- Also epitrochlear gland.
- (2) Gastro-intestinal canal : producing diarrhoea and other disturbances.
- (3) Lungs : cough, areas of consolidation.
- (4) Spinal canal : producing pressure on spinal cord.
- (5) Intracranial symptoms of tumour : rare.

PRESSURE SYMPTOMS.—Numerous pressure effects may occur :—

1. **CERVICAL GLANDS.**—Pressure on trachea, causing cough and dyspnoea, increasing, and finally fatal. Various other effects : Dysphagia, inequality of pupils, protrusion of eyes (sympathetic nerve), œdema of face, paralysis of recurrent laryngeal nerves.
2. **AXILLARY GLANDS.**—Pain and œdema of arms.
3. **MEDIASTINAL GLANDS.**—Signs of thoracic tumour, especially cough, dyspnoea, and cyanosis ; occasionally œdema and dilated veins. Rarely pleural effusion (may be chylous).
4. **RETROPERITONEAL GLANDS.**—Abdominal pain ; may simulate appendicitis, tuberculosis, etc. Pain and œdema of legs. Jaundice, ascites, not uncommon.
5. **INGUINAL GLANDS.**—œdema of legs.
6. **SPINAL CORD AND NERVE ROOTS.**—Sensory and motor changes. Paraplegia. Rarely intracranial symptoms.

Clinical Types.—

1. **CLASSICAL TYPE.**—Origin, symptoms, and general progress as above. Remissions not uncommon. *Death from* : (a) Progressive anæmia and exhaustion ; (b) Dyspnoea from tracheal pressure ; (c) Tuberculosis ; (d) Sepsis, rarely. *Duration* : usually 2 to 5 years.
2. **LOCALIZED TYPE.**—One group may enlarge, with no further extension for prolonged period ; rapid extension may

Hodgkin's Disease—Clinical Types, continued.

finally occur. Group may be : (a) External, e.g., one side of neck ; (b) Internal, e.g., mediastinal or retroperitoneal, (often with perplexing symptoms). Occasionally spleen only. Most chronic form.

3. ACUTE AND GENERALIZED TYPES.—Rapid course ; all glands and lymphoid tissue enlarged.
4. PEL-EBSTEIN SYNDROME.—A remarkable relapsing pyrexia. A period of pyrexia of 10 to 14 days occurs, the temperature rising gradually to a maximum of 103° to 105° , and then steadily falling ; following this is an apyrexial period of 10 to 14 days. The cycle may recur over many months. There may be malaise and increased swelling of glands during pyrexia.
5. LATENT TYPE.—Onset insidious ; malaise, weakness, abdominal discomfort ; temperature constantly high or remittent ; spleen enlarged ; leucopenia. General condition resembles enteric. Retroperitoneal glands enlarged, and perhaps mediastinal, but may be no external glands.

Course and Prognosis.—Invariably fatal. Remissions often occur, especially under treatment. Anaemia and asthenia gradually become extreme, or pressure symptoms develop. Progress in superficial glands varies : they may become enormous, but are sometimes smaller in terminal stages than on first observation.

DURATION.—Usually 2 to 3 years ; a few cases 5 to 10 years.

Diagnosis.—From :—

1. TUBERCULOUS ADENITIS.—Glands tend to be adherent to each other and to skin ; ulceration and caseation common ; spleen not often palpable. But definite diagnosis only by removal and examination of a gland (see MORBID ANATOMY).
2. NEOPLASMS —Sarcoma, lymphosarcoma, lymphoma, etc. Growth rapid ; adherent to and infiltrates skin and tissues. Final diagnosis only by histology.
3. LEUKAEMIA —By blood examination. Distinction difficult (rarely) in early stages of lymphoid leukaemia.
4. SPLENIC ANAEMIA.—Spleen very large ; severe anaemia ; no enlarged glands.
5. SYPHILIS.—Glandular enlargement general and slight.
6. SIMPLE INFLAMMATORY ADENITIS.

The diagnosis in the rare forms with enlarged internal glands only is very difficult.

Treatment.—

1. X RAYS.—Large masses may diminish with great rapidity. But growth (often deep) always finally outruns treatment. Light frequent doses for course of 2 to 3 weeks : repeat. Affected sites to be treated in sequence. Radium less effective.
2. MEDICAL.—Arsenic between X-ray courses.
- 3 SURGICAL.—Glands producing local symptoms should be removed ; otherwise operations inadvisable.

CHAPTER CXLI.

LIPOIDOSES.

Diseases or errors of metabolism resulting in abnormal deposition of lipoids or similar substances, affecting part or whole of the reticulo-endothelial system, and usually associated with splenomegaly.

This is a motley group, for which no title is yet in general use. Knowledge is scanty, and most of the entities are very rare. The manifestations are produced by errors of lipid or similar metabolism which may be (A) secondary, or (B) primary, the symptoms often being closely similar. The substance involved varies in different entities and is not always a lipid. The reticulo-endothelial system is affected by deposition of the substance: such deposition may produce lesions of the parenchyma of various organs.

The group is included in this section on account of the splenomegaly, which is often but not always the presenting symptom.

Lipoid Histiocytosis—This term is also in use, based on involvement of the reticulo-endothelial system.

Classification (provisional).—

A. SECONDARY OR SYMPTOMATIC GROUP.

B. PRIMARY GROUP.—

1. GAUCHER'S DISEASE.—Substance involved: kersasin.
2. NIEMANN-PICK'S DISEASE.—Substance involved: lecithin.
3. SCHÜLLER-CHRISTIAN'S DISEASE.—Substance involved: cholesterol.
4. VON GIERKE'S DISEASE.—Substance involved: glycogen.
5. Residual group.

Blood-sugar curve is often 'flat'. Xanthomatosis common.

Secondary or Symptomatic Group.—Disturbance of lipid metabolism may occur in diabetes, also in chronic jaundice and nephritis. Common sites of storage are spleen and skin (xanthomatosis). May closely resemble primary group.

HYPERCHOLESTEROLÆMIC SPLENOMEGALY IN DIABETES (Schültze's disease).—Occurs with lipæmia and hypercholesterolæmia. Spleen enlarged due to 'foam cells' containing lipid (not double-refractile). Other organs: may include skin (xanthomatosis) and liver (cirrhosis and jaundice). May recover under diabetic treatment.

The primary lipoidoses are described in detail below.

GAUCHER'S DISEASE.

An inborn error of lipid metabolism characterized by splenomegaly, due to distension by peculiar 'Gaucher' cells containing kersasin, which are also present in other organs. Rare.

Etiology.—

SEX.—Seven females to one male. Mainly Jews.

AGE.—Onset in early life. Congenital and familial. Heredity not known.

Gaucher's Disease, *continued*.

Morbid Anatomy.—

SPLEEN.—Greatly enlarged, gray-red colour; scattered white spots due to masses of cells. *Fibrosis* in late stages.

HISTOLOGY.—Masses of large cells ($20 \times 40 \mu$) with small round nuclei distended with lipid material, so-called 'Gaucher-cells'. Cytoplasm is streaky, unlike 'foam cells' of other lipidoses. Pigment is scattered in and between cells, not proved to be hæmosiderin. Similar cells in other sites. Are reticulo-endothelial cells: parenchymatous cells not involved.

GAUCHER CELLS IN OTHER ORGANS.—*Liver*: greatly enlarged (later than spleen). *Bones*: may be thinned by Gaucher cells: seen in radiographs: fractures rare. *Bone-marrow*: may cause anæmia. *Lymphatic glands*: Gaucher cells present but not enlarged. *Skin*: many Gaucher cells.

Pathogenesis.—An inborn error of metabolism. Substance is *kerasin*; is optically inactive; double refractile crystals after heating in water or glycerin: resembles cerebrosides.

Symptoms.—Splenomegaly is earliest sign; *liver* later. Glands rarely palpable. *Skin*: yellowish pigmentation, may be small hæmorrhages; also yellow thickenings at angles of eyes. *Blood*: slight microcytic anæmia, leucopenia, and fall in platelets. *Bones*: may be spinal and other bony deformities. No ascites, jaundice, infantilism, or nervous system lesions.

Course.—General health good. Chronic: duration 20 years or more. Death from intercurrent affections: rarely anæmia or hæmorrhagic diathesis.

Diagnosis.—By spleen puncture.

Treatment.—X rays may diminish size of spleen. Splenectomy contra-indicated

NIEMANN-PICK'S DISEASE.

An inborn error of lipid metabolism resulting in widespread deposition of lecithin with production of splenomegaly and other manifestations.

Etiology.

SEXES.—Females predominate. Mainly Jews.

AGE.—Onset in infancy. Congenital and familial. Heredity unknown.

Morbid Anatomy.—Organs and tissues enlarged by 'foam cells'; being reticulo-endothelial cells distended with lipid material, mainly lecithin (phosphatid). Parenchymatous cells also involved and destroyed. Whole body involved, including nervous system.

Symptoms.—Onset in infancy. Rapid enlargement of spleen and liver, later becomes cirrhotic. Glands enlarged. *Skin*: yellow discoloration where exposed. Emaciation rapid. Ascites, œdema, and bronchitis. *Blood*: lipæmia present; cholesterol normal or

high; some anæmia; leucocytosis, cells containing lipid vacuoles. Whole body affected, including nervous system; may be Tay-Sachs syndrome.

Prognosis.—Fatal by 2 years old. No treatment.

Diagnosis.—By spleen puncture and blood changes.

Note.—Tay-Sach's disease is probably similar, with localized deposition.

SCHÜLLER-CHRISTIAN'S DISEASE.

(*Hand-Schüller-Christian's Disease.*)

An inborn error of lipid metabolism resulting in deposition of cholesterol, especially in bones, with formation of granulomatous tissue.

Etiology.—

SEX.—Males only. Mainly Jews.

AGE—Onset in early childhood. Congenital and familial.

Morbid Anatomy.—Essential process is deposition of cholesterol or its ester forming 'foam' cells; reticulo-endothelial cells affected, but also parenchymatous cells which are destroyed; yellow granulomatous tissue forms, containing 'foam' cells.

BONES—Specially affected: *skull* chiefly, or may be solely; also face, pelvis, and extremities; fractures rare.

SKULL—Granulomatous tissue may: (1) Perforate bone, may form external bosses; (2) Invade orbit, causing exophthalmos; (3) Invade accessory sinuses and press on pituitary.

Skin, bone-marrow, and other tissues and organs affected.

Symptoms.—

CHARACTERISTIC TRIAD.—(1) *Bony defects*; (2) *Exophthalmos*; (3) *Diabetes insipidus* and other signs of hypopituitarism.

SKIN.—Yellow discoloration: may be nodules and xanthomatosis.

SPLEEN.—Moderate enlargement.

Also liver (may fibrose), glands, kidneys.

BLOOD.—(1) Hypercholesterolæmia—usual but may be absent; (2) Anæmia, may become extreme.

BLOOD-SUGAR.—Curve flat.

Course.—May be mild, with duration 20 years or more. Death from intercurrent disease, anæmia, or dyspnoea. Some recover.

Diagnosis.—*Radiographs*: scattered defects in bones. Sternal puncture.

VON GIERKE'S DISEASE.

An inborn error of metabolism resulting in abnormal deposition of glycogen in the tissues, especially in the liver.

Etiology.—

SEX.—Occurs in both sexes.

AGE.—Onset in infancy. Congenital and familial. Several cousin-marriages recorded: may be inherited as Mendelian recessive character.

Von Gierke's Disease, *continued*.

Pathogenesis.—Glycogen deposited in excess in cells of liver, kidney, heart, etc.: liver greatly enlarged, also frequently kidney (but not invariably, as von Gierke believed).

BLOOD GLYCOGEN.—Increased, especially in red cells.

BLOOD CHOLESTEROL.—High.

BLOOD-SUGAR.—Fasting level low. Tolerance test: often no rise. Injections of adrenaline: no rise (short initial).

URINE.—Ketonuria.

Error in glycogen metabolism includes (but is not solely) difficulty in splitting and hence in mobilizing from the organs as sugar.

Symptoms.—Enlargement of liver, from early childhood: becomes enormous. Lack of growth and development, continuing to infantilism: usually thin, less often obesity. General health fair. Convulsions may occur (hypoglycæmic). No jaundice. Spleen not enlarged.

Course.—No treatment effective. High carbohydrate diet of doubtful value. Rarely recovery.

RESIDUAL GROUP.

A group of lipoid diseases exhibiting various features, especially splenomegaly, and biochemical abnormalities—e.g., flat blood-sugar curves, hypercholesterolemia, and occasionally with (osteosclerotic) anæmia and xanthomatosis.

Section IX.—DISEASES OF THE CIRCULATORY SYSTEM.

CHAPTER CXLII.

CARDIAC SOUNDS AND MURMURS.

HEART SOUNDS.

Causes of Heart Sounds.—

THE FIRST SOUND is produced by: (1) Closure of mitral and tricuspid valves; (2) Contraction of ventricular muscle in systole (whence prolongation and slight dulling).

THE SECOND SOUND is produced by closure of aortic and pulmonary valves.

Normally:—

At mitral and tricuspid areas: first sound louder than second.

At aortic and pulmonary areas: second sound louder than first.

Aortic second sound fainter in youth than pulmonary second and louder in age.

Variations in Heart Sounds.—

FIRST SOUND.—

FEEBLENESS AND SHORTNESS.—Suggests muscular exhaustion (when other signs present). Distant heart sounds commonly due to emphysema, thick chest wall, or old age.

ACCENTUATION.—In mitral stenosis, also in simple tachycardia of excitement or exertion.

a. In dilatation: accentuated, but clear and short. Thin stretched wall vibrating rapidly and also transmitting sound readily.

b. In hypertrophy: accentuated, but dull and prolonged. Thick muscle contracting powerfully, but vibrating slowly and damping sound.

REDUPLICATION.—Mitral and tricuspid valves closing separately—i.e., left and right ventricular systole asynchronous.

LOUD SHORT SOUND and systolic shock *at apex* in mitral stenosis; may occur with completely calcified mitral valves. Due to impact of blood against firm valves and ring; or, according to Broadbent's theory, to contraction of only half-filled left ventricle.

SECOND SOUND.—

ACCENTUATION.—Increased momentum of reflux blood on valves: either from increased velocity—e.g., high blood-pressure—or from increased mass—e.g., aortic aneurysm.

Variations in Heart Sounds—Second Sound, *continued*.

REDUPLICATION.—Occurs either at base or apex, especially in mitral stenosis. Theories:—

- a. At base: Asynchronous closure of aortic and pulmonary valves owing to abnormal relative blood-pressures.
- b. Audible at apex and not at base—common in early mitral stenosis: Is of mitral origin; the mitral valves, opening at onset of ventricular diastole, are checked by adhesion of their edges and vibrate in the blood-stream. The second element of the reduplication is thus due to the *opening* of the mitral valves, and so is not truly a 'reduplicated second sound'.

GALLOP RHYTHM.—Three sounds in series, accent usually on second. The last sound is in relation to the first of the next series and represent, a division of ventricular contraction, the apex beat being correspondingly double. Only occurs when heart rapid, most common in hypertension, coronary thrombosis and congestive failure, rare in mitral stenosis or auricular fibrillation, Is sign of serious myocardial failure in hypertrophied heart. No relation to heart-block or other reduplicated sounds.

'MUFFLED' SOUNDS.—In febrile conditions. May or may not develop into murmurs. Also in pericardial effusion.

EFFECT OF INSPIRATION with normal heart.—At beginning the first sound, and at end the second sound, may reduplicate.

INAUDIBILITY OF THE SECOND SOUND AT THE APEX.—Common in later stages of severe mitral stenosis.

- CAUSES.**—(1) Diminished blood-supply to aorta, and hence feeble aortic recoil (second sound at apex is mainly aortic); (2) Enlarged right ventricle and auricle displace the left ventricle, which is chief conductor of second sound.

CARDIAC MURMURS.

Classification of Murmurs.—

I. ENDOCARDIAL.—

1. PHYSIOLOGICAL.
2. FUNCTIONAL: (a) Hæmic; (b) Relative incompetence (c) Febrile.
3. ORGANIC.
4. CONGENITAL.

II. EXOCARDIAL.—

1. PERICARDIAL.
2. CARDIO-PULMONARY.

Note.—'Endocardial' includes all murmurs produced within visceral pericardium, and does *not* imply origin from endocarditis.

I. ENDOCARDIAL MURMURS.

1. **Physiological Murmurs.***—Certain negligible *soft, systolic* murmurs occurring in apparently healthy hearts. Evidence: (a) No alteration in size of heart; (b) No impairment of function; (c) Life unshortened; (d) No post-mortem changes.

*To be diagnosed with caution, only after full physical tests and repeated examinations at long intervals. Formerly included among functional murmurs.

2. Functional Murmurs.—Murmurs not due to organic disease of the valves or valve rings. Always systolic.

a. HÆMIC MURMURS.—

OCCURRENCE.—Frequent in anæmia and allied conditions, e.g. exophthalmic goitre.

SITE.—At base, second left intercostal space, usually about 1 inch from edge of sternum. Less commonly at mitral area.

CHARACTERS.—Always systolic. Localized. Usually soft and blowing. Often variable: disappearing on rest, or, per contra, on exertion (viz., slowing or accelerating pulse); or on firm pressure by stethoscope.

THEORIES OF ORIGIN (basal murmur).—

i. Dilatation of pulmonary artery beyond valves, and diminished viscosity of blood (generally accepted).

ii. Relative incompetence of mitral valve, regurgitation causing vibration in *auricular appendix*, audibility being increased by the retraction of left lung common in anæmia (Balfour). Evidence for: Murmur occurs to left of pulmonary area. Evidence against: Auricular appendix very rarely visible from front of thorax, and when so, at least $1\frac{1}{2}$ inches from sternum (*see below*, NAUNYN'S THEORY).

b. RELATIVE VALVULAR INCOMPETENCE.—From *muscular dilatation*.

OCCURRENCE—(1) Severe fevers; severe anæmia. (2) Dilated ventricles; aortic or renal disease; adherent pericardium.

Note.—Even with extreme dilatation there may be no murmurs.

c. FEBRILE MURMURS.—Frequent in febrile conditions.

CHARACTERS.—*Apical* systolic murmur, soft, not conducted, pulmonary second sound not accentuated, area of cardiac dullness not increased.

ORIGIN unknown (? contraction of abnormal muscle, or intraventricular currents).

3. Organic Murmurs.—Due to disease of the valves or valve-rings. Systolic, diastolic, mid-diastolic, or presystolic, but position in the cardiac cycle remains constant.

DISTINCTIVE QUALITIES.—(a) Area of maximum intensity; (b) Time in cycle; (c) Direction of conduction.

CHARACTERS.—Rough, or soft and blowing (latter usually regurgitant murmurs). Often '*musical*'. Constant, or change slowly, and little affected by alterations in posture, etc.

MITRAL AREA.—

PRESYSTOLIC MURMUR.—*Mitral stenosis*. Occurs in auricular systole, hypertrophied auricle driving blood through a stenosed orifice. *Site*, at apex beat, or frequently to right of the impulse. *Not conducted*: often localized to small area.

Crescendo, ending sharply in loud first sound. (Presystolic murmurs also occur in: (a) Aortic incompetence (Austin Flint murmur); (b) Adherent pericardium.)

SYSTOLIC MURMUR.—*Mitral incompetence*. Accompanies or replaces first sound. Maximum at beginning, fades off

Endocardial Murmurs—Organic—Mitral Area, *continued.*

gradually. Due to regurgitation of blood from ventricle to auricle. *Direction of conduction*: into left axilla, often audible also at angle of scapula. *Very rarely* maximum point to right of apex, conducted upwards towards second left space.

Theory of conduction (doubtful).—(1) Into axilla: from disease of posterior valve flap. (2) Upwards to second left space: from disease of anterior valve flap.

Naunyn's theory: Due to vibrations caused in left auricular appendix. Improbable, but may be cause of audibility at scapula.

MID-DIASTOLIC OR DIASTOLIC MURMUR.—Follows the second sound. Maximum at onset, fades off gradually. Occurs in *mitral stenosis*. Presystolic murmur, if present, follows immediately or after short interval.

Cause: Relaxing ventricle in diastole results in flow of blood through stenosed orifice.

AORTIC AREA.—

SYSTOLIC MURMUR.—*Aortic stenosis*. Loud rough murmur, maximum at aortic cartilage, and conducted upwards into carotids.

Note.—Aortic systolic murmurs are common, and usually due to roughened valves and causes other than stenosis (see **AORTIC STENOSIS**, p. 807).

DIASTOLIC MURMUR.—*Aortic incompetence*. Soft, blowing murmur; often audible earliest and best to left of sternum; conducted down sternum.

TRICUSPID AREA.—

PRESYSTOLIC MURMUR.—May occur in tricuspid stenosis, but is usually absent.

SYSTOLIC MURMUR.—Soft murmur. Localized, or conducted to right. Occurs in tricuspid incompetence, but diagnosis justified only with concomitant venous pulsation.

PULMONARY AREA.—Murmurs extremely common, but disease of valves rare.

SYSTOLIC MURMURS.—(1) In healthy thin subjects: especially in expiration, in children. (2) Febrile and other rapidly beating hearts. (3) Hæmic murmurs. (4) Cardio-pulmonary murmurs. (5) Pulmonary stenosis and other congenital lesions. Rarely: (6) Mitral incompetence: murmur conducted upwards.

DIASTOLIC MURMURS.—(1) Aortic incompetence. Extremely rare: (2) Pulmonary incompetence. Occasionally: (3) Mitral stenosis, late stages: transient incompetence from high pulmonary pressure (Graham Steell); murmur disappears when tricuspid incompetence occurs.

BRUIT DE DIABLE.—Audible in neck in conditions of low blood-pressure: ascribed to alterations in calibre of the veins in the neck leading to compression on passage over cervical fascia.

4. Congenital Murmurs.—Practically always to left of sternum, in neighbourhood of pulmonary area. (See **CONGENITAL AFFECTIONS OF THE HEART**, p. 826.)

II. EXOCARDIAL MURMURS.

1. **Pericardial Murmurs.**—In acute pericarditis.
TIME.—Systolic or 'to-and-fro', but not corresponding accurately to onset of systole or diastole.
SITE.—To left of sternum, near centre of cardiac dullness; or close to sternum.
CHARACTERS—Very superficial; grating or creaking character; localized; vary rapidly; often affected by changes of posture and respiration, but *not abolished by holding breath*.
2. **Cardio-pulmonary Murmurs.**—Occur in diseased conditions where heart and lung meet—e.g., adhesions, dilated heart; some due to systole sucking in, and diastole expressing air from, a portion of lung.
SITE.—Usually to left of cardiac dullness; sometimes at base.
CHARACTERS.—Generally late systolic; short; affected by respiration, maximum in unforced inspiration. May be audible in trachea.

DIFFERENTIATION OF FUNCTIONAL AND ORGANIC MURMURS AUDIBLE AT MITRAL AREA.

An *apical systolic murmur* may be: (a) Febrile; (b) From relative incompetence; (c) Organic.

1. **During Acute Fever.**—In absence of other cardiac signs, immediate differentiation of (a), (b), and (c) is impossible: diagnosis depends on subsequent watching.
 As temperature falls: (i) murmur subsiding—condition may be (a) or (b); (ii) murmur more marked—probably (c).
Note.—At onset, a murmur may be due to (a) or (b), and later be due to (c), especially in acute rheumatic fever.
2. **Murmur Persists after Apyrexia.**—To decide importance of murmur, consider: (a) Size of heart. (b) Rate and rhythm: (i) Rapid rate suggests organic murmur; (ii) Slow, suggests functional murmur. (c) Response to effort. (d) Advance or alteration in murmur over a long period.

CHAPTER CXLIII.

PERICARDITIS.

Inflammation of the pericardium, simple or suppurative, arising by spread through the blood-stream, by extension from neighbouring organs, or by injury.

Etiology and Classification.—

1. **PRIMARY IDIOPATHIC PERICARDITIS.**—Extremely rare. Usually pneumococcal.

Pericarditis—Etiology and Classification, *continued*.

2. SECONDARY PERICARDITIS.—Causes:—

- a. INFECTIVE TOXIC PROCESSES CONVEYED THROUGH THE BLOOD-STREAM OR LYMPHATICS.—
 - i. Rheumatic pericarditis, rheumatic fever, or chorea.
 - ii. Pericarditis in pneumonia.
 - iii. Septic pericarditis: In septicæmia of any origin, especially puerperal fever and acute necrosis of bone. Invariably fatal.
 - iv. Terminal pericarditis: In chronic nephritis, diabetes, and debilitating conditions.
 - v. Acute specific fevers: In scarlet fever. In enteric, rarely. Others very rarely.
 - vi. Tuberculous pericarditis.
 - b. DIRECT EXTENSION OF INFLAMMATION.
 - c. INFARCT OF THE HEART.—Coronary thrombosis.
 - d. TRAUMA.—Perforating wounds, fractured ribs, foreign bodies in œsophagus, etc.
- Groups i to iv include nearly all the cases.

Rheumatic Pericarditis.—Never becomes purulent.

OCCURRENCE.—Most frequent in early life, between ages of 5 and 20. Accounts for nearly all cases of pericarditis occurring at this period. Rare after age of 25. Males and females equally affected.

RELATION TO MANIFESTATIONS OF RHEUMATISM.—In children, arthritis often slight. May occur with acute tonsillitis only; or with chorea, especially when *rheumatic nodules* are present. In adults, generally with severe arthritis. Endocarditis usually present, and in children nearly always.

TIME OF ONSET DURING COURSE OF ACUTE RHEUMATISM.—Variable. In children usually late in attack. May precede arthritis. May occur in first or any subsequent attack; most frequently in first.

Pericarditis in Pneumonia.—Not uncommon complication in pneumonia, bronchopneumonia, and empyema. More common when right lung is affected. Most frequent under age of 5; at that period is commonest cause of pericarditis. Dry pericarditis is often not diagnosed (owing to râles obscuring rub). An effusion usually becomes purulent, and is almost always fatal. Organism generally pneumococcus. Condition is usually ascribed to direct extension of inflammation, but may be a common infection through the blood. Thus pneumococcal pericarditis may be primary or may precede lung affection.

Terminal Pericarditis.—May occur in any chronic illness. In nephritis—rare under age of 35. Most frequent in chronic nephritis. Effusion does not become purulent, is usually of small amount, not diagnosed, and clinically unimportant.

Tuberculous Pericarditis.—Rare. May be: (1) Primary; or (2) With pulmonary tuberculosis. Either: (i) with effusion, clear, turbid, or blood-stained; (ii) miliary tubercles; (iii)

tuberculous masses. In chronic forms, great thickening of pericardium. (3) General induration of the serous membranes (polyorrhomenitis): probably not always tuberculous.

Direct Extension of Inflammation.—From disease of neighbouring organs and tissues, e.g., glands, sternum, ribs; rarely neoplasms (sarcoma only). Possibly also in pneumonia.

CLINICAL VARIETIES OF PERICARDITIS.

Three groups may be recognized pathologically and clinically: (1) Acute fibrinous or sero-fibrinous pericarditis; (2) Pericarditis with effusion; (3) Adherent pericardium (chronic adhesive pericarditis).

1. ACUTE FIBRINOUS OR SERO-FIBRINOUS PERICARDITIS.

Morbid Anatomy.—Changes similar to inflammation of other serous membranes. Progressively: (1) Hyperæmia; (2) Loss of lustre of surface; (3) Fibrinous exudation, at first easily removable, increasing in amount. Surface becomes shaggy, 'bread-and-butter' appearance; some exudation of fluid. Amount of fibrin and fluid variable. In 'dry or plastic pericarditis' effusion slight, and adhesions may form rapidly; most common in children. In severe cases myocardium affected.

Symptoms.—Often slight, and condition not diagnosed.

1. PAIN.—Often absent, especially in young children, rarely severe, not increased by pressure. Precordial; less often epigastric.
2. DYSPNŒA.—May be cyanosis.
3. FEVER.—Usually present, no special course. In rheumatic form, hyperpyrexia may occur.

In acute rheumatism, pericarditis suggested by dyspnœa, pallor, a pinched expression, and a feeble rapid pulse.

Physical Signs.—

FRICTION SOUND ON AUSCULTATION.—Sole physical sign: pathognomonic when present. Due to rubbing of inflamed surfaces; absent when much fluid present.

SITE.—To left of sternum, near centre of cardiac dullness, or close to sternum.

TIME.—Systolic or 'to-and-fro', but not corresponding accurately to onset of systole or diastole.

CHARACTERS.—Very superficial; grating or creaking in quality; usually very local. Tends to vary, and often only present intermittently. Not abolished by holding breath. (In pneumonia, may be obscured by râles in lungs.)

ON PALPATION.—Rarely, fremitus.

Diagnosis.—Friction sound pathognomonic: in absence, diagnosis often impossible. Diagnosis from:—

1. ENDOCARDIAL MURMURS.—Distinguished by characteristics as above.

Pericarditis—Acute Fibrinous—Diagnosis, *continued*.

2. PLEURO-PERICARDIAL FRICTION.—Common in pneumonia. Murmur greatly affected by respiration. Endo-pericarditis often simultaneously present.

Also from aortic to-and-fro murmur, if rough and heart rapid.

Termination.—(1) Organization of the fibrin, viz., adherent pericardium. (2) Increase of the fluid, viz., pericarditis with effusion. Very rarely, chronic pericarditis, probably tuberculous. Death may occur at any stage from the associated disease.

Treatment.—See PERICARDITIS WITH EFFUSION.

2. PERICARDITIS WITH EFFUSION.

Etiology.—Often follows dry pericarditis, forming the second stage, most commonly in rheumatic and septicæmic types.

Morbid Anatomy.—

CHARACTER OF EFFUSION.—May be:—

1. SERO-FIBRINOUS.—Especially in acute rheumatism.
2. PURULENT.—In septic forms, never in acute rheumatism. In pneumococcal infections, large purulent flakes are present.
3. HÆMORRHAGIC.—Rare. In neoplasms, and occasionally in tuberculosis.

AMOUNT OF FLUID.—Largest in rheumatic type, but is usually small in children; commonly about 300 c.c. (10 oz.).

Symptoms.—*Onset* may be latent, and effusion when moderate remain undiagnosed. The severity and combination of the following symptoms vary greatly:—

1. GENERAL APPEARANCE.—Anxious and pallid, often suggestive. Cyanosis.
2. RESTLESSNESS AND INSOMNIA.—Common; in severe cases may be extreme. *Delirium* not uncommon; especially occurs with hyperpyrexia.
3. DYSPNŒA.—The most common symptom; increases with amount of effusion, and often becomes extreme. Upper costal breathing marked. Pulse-respiration ratio may reach 2 to 1. Patient most comfortable on left side or semi-recumbent.
4. PAIN.—Commoner in effusion than in dry pericarditis. Varies from sense of tightness to severe pain. Situation precordial, or, in later stages, epigastric. Increased by pressure on sternum. Distribution may be anginal, or in either side from pleurisy. Precordial hyperæsthesia may occur.
5. PULSE.—Rapid, but not distinctive—may be irregular. Pulsus paradoxus is occasionally present (pulse weakens during inspiration).
6. TEMPERATURE.—Not invariably raised. Rarely exceeds 103°. Hyperpyrexia occurs in rheumatic forms.
7. VOMITING.—Occasionally severe.
8. VARIOUS PRESSURE SYMPTOMS.—Irritable cough. More rarely dysphagia, hiccup (affection of phrenic nerve), or aphonia.

Physical Signs (of large effusions).—

INSPECTION.—Deficient movement of left side. *Cardiac impulse* wavy or absent. Veins in neck may be distended.

PALPATION.—*Apex beat slight or absent* (disappearance may be watched during accumulation of fluid). Pulsation often in fourth space, produced by wall of right ventricle.

PERCUSSION.—**CARDIAC DULLNESS:—**

1. *Note* very dull and sharply defined from lung.
2. *Area increased*, described as pear-shaped. Marked increase to right in fifth space (Rotch's sign). To left, *extends beyond apex beat*.
3. Increases rapidly with effusion. Shape and extent may vary with posture.

AREA OF DULLNESS AND BRONCHIAL BREATH-SOUNDS at angle of left scapula, and often in axilla, due to collapse of lung (Bamberger's sign). Most frequently found in young people.

AUSCULTATION.—

HEART SOUNDS.—*Muffled*. Pulmonary second sound accentuated.

FRICTION SOUND.—Occasionally persists during effusion, especially at base or when patient is erect; often reappears during absorption.

Diagnosis.—Often overlooked owing to the severity of the associated disease. In rheumatic fever is usually easy, in pneumonia very difficult. Pleural effusion.

FROM CARDIAC DILATATION.—Diagnosis often difficult.

Note:—

1. In effusion: large extent of dullness, with small degree of impulse.
2. **HEART SOUNDS.**—(a) In dilatation, sharp and clear; (b) In effusion, muffled.
3. **RIGHT EDGE OF DULLNESS.**—(a) In dilatation, roughly parallel to sternum; (b) In effusion, curves concavely to the right. (Value doubtful.)
4. *Compression of lung rare in dilatation.*
5. Radiographs may assist.

The nature of the primary disease is the only guide to the character of the fluid.

Course.—Rapidity of accumulation and absorption of fluid varies greatly—a large effusion may form in a few days.

Prognosis.—

1. **IMMEDIATE PROGNOSIS.**—Depends on primary disease. (a) Sepsis: invariably fatal. (b) Pneumococcal group: prognosis serious. (c) Rheumatic group: fluid never purulent, most cases recover; prognosis varies with degree of dilatation. (d) Tuberculosis: usually chronic, finally fatal.

Pericarditis with Effusion—Prognosis, *continued*.

2. REMOTE PROGNOSIS.—In rheumatic group, in rare cases, there is complete clinical recovery.

ADHESIONS are constant sequel of pericarditis (*see* ADHERENT PERICARDIUM).

Treatment of Pericarditis.—

GENERAL INDICATIONS.—(1) Support heart muscle; (2) Allay inflammation. Treatment is directed to: (a) Diminution of heart-beats; (b) Local treatment of the pericardium; (c) Treatment of special symptoms.

IN STAGE OF ACUTE PERICARDITIS.—

REST.—Absolute. Posture as patient prefers.

DIET.—Light and nourishing.

BOWELS.—Open freely. Salines.

ICE-BAG TO PERICARDIUM should be applied continuously; weight supported; packed round with absorbent wool to gather condensing moisture. Chest wall must feel cold to be effective. Flying blisters less effectual.

DRUGS.—Stimulants are inadvisable.

IN STAGE OF EFFUSION.—Continue above treatment, but not too limited diet. Leeches, 3 or 4, should be applied once.

SPECIAL SYMPTOMS.—

RESTLESSNESS OR INSOMNIA.—Bromide and opium (nepenthe, Dover's powder gr. x, or injection of morphia).

VOMITING.—Alkalis and hydrocyanic acid. Peptonized milk.

LIVIDITY AND RESPIRATORY DISTRESS.—Oxygen inhalations.

PARACENTESIS, aspiration of the pericardium.—

INDICATIONS.—(1) Effusion large; (2) Dyspnœa and restlessness severe.

TECHNIQUE.—Insert needle in angle between ensiform and left costal margin, and pass upwards and inwards.

ASSOCIATED DISEASE must be treated—e.g., salicylates in acute rheumatism.

CONVALESCENCE.—Must be extremely slow. (1) Three weeks' complete rest in bed after pulse and temperature are normal. (2) Further three weeks mainly in bed. (3) Subsequently, four months' careful convalescence before an adult is permitted to return to work.

3. ADHERENT PERICARDIUM.

(*Chronic Adhesive Pericarditis*.)

Pericardial adhesions are a sequel of pericarditis, either acute or with effusion.

There are two types:—

1. INTRAPERICARDIAL ADHESIONS.—Pericardial layers adherent. Sac obliterated partly or completely. Symptoms often slight or absent even when complete, and physical signs indefinite.

2. **EXTRAPERICARDIAL ADHESIONS.**—Pericardium adherent to surrounding structures, especially sternum; also to lungs, diaphragm, and mediastinal structures. Internal adhesions also present. This is the condition commonly diagnosed as 'adherent pericardium'. *Extreme hypertrophy* and dilatation of the heart occurs: weight up to 40 or more ounces.

Causation.—(1) Acute rheumatism: especially in children: predominant cause. (2) Pneumococcal pericarditis. (3) Tuberculosis or generalized serositis rare (*see p. 553*).

Symptoms.—Latent, as in compensated valvular lesions; or as in *cardiac failure*. (Valvular lesions frequently coexist.)

Physical Signs.—

INSPECTION.—The diagnosis depends on inspection, the most characteristic signs being:—

1. **ASYMMETRY OF THE CHEST** and pericardial bulging due to the extreme enlargement of the heart.
2. **CARDIAC PULSATIONS MARKED.**—Undulations pass from the third space to the apex. Apex beat wavy.
3. **SYSTOLIC RETRACTION** of the apex beat: not always present.
4. **ADHESIONS TO THE DIAPHRAGM AND OTHER STRUCTURES** cause various symptoms: (a) Immobility of the sternum during inspiration (Wenckebach's sign); (b) Systolic retraction in 7th and 8th left interspace in axilla, and 11th interspace posteriorly (Broadbent's sign); (c) Absence of respiratory movements in epigastrium; (d) Diastolic collapse of cervical veins (Friedreich's sign).

PALPATION.—Apex beat is fixed, no change in position on moving patient on side (of little value). Diastolic shock over precordium (very rare).

PERCUSSION.—Area of cardiac dullness greatly increased.

AUSCULTATION.—Depends mainly on associated lesions. In rheumatic cases there is usually a systolic murmur of mitral insufficiency, and very frequently a *presystolic murmur*.

PULSE.—The pulsus paradoxus may be present.

RADIOGRAPHS.—May be diagnostic.

Prognosis.—Very bad—young people usually die during strain of puberty. Those survive best in whom physical growth is slight. Prognosis most grave with large hearts and signs of mediastinal adhesions. Death due to cardiac failure.

Treatment.—In general, as for cardiac failure and compensated lesions.

CARDIOLYSIS.—Removal of 4th, 5th, and 6th left ribs. Should be performed in selected cases. Frees the pericardium from the extrapericardial adhesions. The sternum may also be divided above and below area of adhesion.

CHAPTER CXLIV.

DISTURBANCES OF THE CARDIAC CONTRACTIONS.

I. NORMAL AND ABNORMAL CARDIAC CONTRACTIONS.

The Controlling Mechanism of Cardiac Contractions.—

1. INTRACARDIAL.—The contractions are under the control of remnants of the 'primitive cardiac tube'. These form a chain of connections, and are the junctional tissues from the great veins through the auricle to the ventricle. They consist of :—
 - a. SINO-AURICULAR NODE (Keith and Flack).—Close to orifice of superior vena cava, at termination of sulcus terminalis. Hence connections proceed :—
 - b. THROUGH THE AURICLE.—On posterior wall and inter-auricular septum. Connecting with :—
 - c. AURICULAR-VENTRICULAR NODE.—On right side of base of inter-auricular septum, internal to orifice of coronary sinus. Whence arises :—
 - d. AURICULO-VENTRICULAR BUNDLE (Bundle of His).—Fibres have large nuclei, faint striation, and stain pale. The main bundle runs below the interventricular septum, the pars membranacea, and divides into right and left septal divisions. These subdivide, pass to papillary muscles, and form a network communicating with muscle fibres.
2. EXTRACARDIAL —
 - a. VAGUS.—Normally inhibits rate of contractions. In complete absence of vagal control, human auricle probably would contract at rate of 150 to 160.
 - b. SYMPATHETIC SYSTEM.—Supplies accelerator fibres to heart. From first four dorsal segments, through inferior cervical ganglion.

Origin of Normal Contractions.—*Normal stimuli* causing contractions arise in the *sino-auricular node*, hence called the 'pacemaker' (Lewis), and follow the course of the primitive cardiac tissue, stimulating consecutively auricle and ventricle.

Origin of Abnormal Contractions.—These may arise as follows :
 (1) Stimuli can originate from any portion of the primitive cardiac tissue. (2) Stimuli, either normal or abnormal, may be blocked by disease in the junctional tissues either partially or completely, or by meeting muscle in 'refractory' state. The two types may, and frequently do, coexist.

Classification of Abnormalities of Contraction.—

1. VARIATIONS IN VAGUS CONTROL.—

SINUS ARRHYTHMIA.

SIMPLE TACHYCARDIA AND BRADYCARDIA.

2. ABNORMALITIES OF STIMULI.—

EXTRASYSTOLES (premature contractions).

PAROXYSMAL TACHYCARDIA.

AURICULAR FIBRILLATION.

AURICULAR FLUTTER.

3. INTERFERENCE WITH PASSAGE OF STIMULI.—

HEART-BLOCK.

4. IMPAIRMENT OF CONTRACTILITY.—

PULSUS ALTERNANS.

Group 2 includes abnormalities of very varying importance and symptomatology. Paroxysmal tachycardia is, pathologically, the regular repetition of an extrasystole, but has no clinical relation to it.

The Functions of Cardiac Muscle (enunciated by Gaskell).—

(1) Stimulus production—rhythmicity; (2) Excitability; (3) Contractility; (4) Conductivity; (5) Tone.

Abnormalities of contractions have been classified also on the basis of these functions (unsatisfactory).

II. PALPITATION.

Consciousness of temporarily abnormal action of the heart.

Note.—‘Palpitation’ is a symptom present and complained of in many conditions, and not a clinical entity.

Two factors must be present: (1) Consciousness of the heart-beat; (2) Abnormality—in increased force, increased rapidity, or irregularity. Consciousness of *normal* heart-beat in debility is thus excluded.

ABNORMALITY may be:—

REGULAR AND RAPID: e.g., common in emotions, after exertion, etc.; also auricular flutter and paroxysmal tachycardia.

IRREGULAR AND RAPID: e.g., auricular fibrillation.

IRREGULAR, NOT NECESSARILY RAPID: e.g., extrasystoles, common form. Consciousness may refer to (1) the pause, (2) the big beat following the extrasystole.

FORCIBLE, NOT NECESSARILY RAPID: e.g., emotions, hysteria.

Etiology.—

1. **EXCITABILITY OF NERVOUS SYSTEM.**—Common type. Emotions; hysteria; neurasthenia; puberty, menopause, menstruation. ‘Irritable heart’ (‘disordered action of the heart’). Anæmia and debilitating conditions.
2. **TOXIC.**—Acute fevers. Tobacco; tea; alcohol.
3. **GASTRIC REFLEX.**—In dyspepsia.
4. **ORGANIC DISEASE OF HEART.**—Valvular. Myocardial. Disorders or rhythm. (Palpitation often absent.)

Symptoms.—Complaint varies with the type of abnormality—viz., fluttering, throbbing, or ‘heart stands still’ (pause in extrasystoles). Various degrees of lassitude, cardiac distress, mental depression, and fear. When severe: sitting preferred, pressure applied to heart, deep breaths taken.

Palpitation—Symptoms, *continued*.

Duration.—Few minutes to hours. Termination gradual, or, less often (but especially in gastric group), sudden. In neuroses, at cessation, often passage of much pale urine or flatulent eructations.

Physical Signs.—In neurotic cases negative: sounds clear and loud: may be hæmic murmurs: vessels often throbbing and dilated.

Prognosis.—Depends on cause. In neurotic group, life not shortened. In toxic group, recovery good with removal of cause.

Treatment.—In youth, sharp walk often terminates attack. Feelings of exhaustion and depression need rest. Treat etiological factor.

III. TACHYCARDIA.

Increased rapidity of the heart occurs in many conditions; it may be continuous or discontinuous; is often associated with irregularities of rhythm.

VARIETIES.—

1. SIMPLE TACHYCARDIA.

2. PAROXYSMAL TACHYCARDIA.—(a) Paroxysmal tachycardia, simple, nodal, or ventricular; (b) Auricular fibrillation (*see* p. 785); (c) Auricular flutter (*see* p. 783).

The essential difference between these groups is that in the first, simple tachycardia, the cardiac impulse starts at the normal site, the 'sino-auricular node', and is an increased rate of normal stimulus production; while in the second, paroxysmal tachycardia, it starts at some other spot, and is an abnormal rhythm. The electrocardiogram alone can prove this: in practice, diagnosis is usually ascertainable by other means

1. SIMPLE TACHYCARDIA.

VARIETIES.—

1. SIMPLE DISCONTINUOUS TACHYCARDIA.—Rate normal when undisturbed, but response excessive to (a) exertion (due to slight reserve power of heart); (b) emotions; or both. Not invariably, but frequently, constitutes 'palpitation'.

2. SIMPLE CONTINUOUS TACHYCARDIA.—Rate continuously increased. Usually, in addition, excessive response to exertion or emotion, as in above, these generally constituting 'palpitation'.

OCCURRENCE.—The most important conditions are:—

a. ACUTE FEVERS.

b. DEBILITATING CONDITIONS.—(i) Phthisis (early and important sign). (ii) Result of prolonged pyrexia; especially in convalescence of enteric and influenza. (iii) Anæmia; wasting from any cause; hæmorrhage.

c. ORGANIC DISEASES OF THE HEART, valvular and myocardial.

d. EXCITABILITY OF THE NERVOUS SYSTEM.—(i) Emotions;

hysteria; neurosis. (ii) 'Irritable heart' ('disordered action of the heart'). (iii) Menstruation, menopause, puberty; also in pregnancy. (iv) Reflexes—c.g., gastric flatulence.

c. EXOPHTHALMIC GOITRE.

f. TOXIC.—Alcohol. Tobacco. Thyroid extract. Various drugs.

g. PHYSIOLOGICAL.—The average adult rate is about 72. In exceptional cases it may be 85 to 90.

SYMPTOMS.—Attack of palpitation and throbbing, giddiness, buzzing: may be precordial discomfort. Apex beat diffuse.

CHARACTERISTICS.—

a. Rate rarely exceeds 140.

b. Rate affected markedly by exertion or rest, emotion, alterations of posture, by atropine and other drugs. Alteration of posture, standing to lying, may slow heart 20 to 30 beats: normal change not above 10. Slows with rest.

c. Heart does not dilate.

d. Attacks of tachycardia begin and cease gradually; rate during attack may vary considerably.

e. Entire heart contracts more rapidly, diastole shortened more than systole. Conduction of stimulus from auricle to ventricle is accelerated, viz., a-c interval diminished.

f. Peripheral vessels dilated and often throbbing. Pulse tracing shows sharp up-and-down stroke, from relaxation of arterial wall.

g. Electrocardiogram normal. Stimulus arises at normal 'pacemaker', the sino-auricular node.

Irritable Heart.—Occurs in young soldiers and occasionally in civilian life. Is the result of mental and bodily strain, exhibited by cardiac manifestations

SYNONYMS.—Effort syndrome. Disorderly action of the heart (D.A.H.). Da Costa's irritable heart.

SYMPTOMS.—Palpitation, throbbing, dyspnoea; vasomotor symptoms, c.g., cold hands; exhaustion. Pulse rapid and accelerates markedly on slight stimulation. Heart: apex beat forcible; no dilatation; may be systolic murmur, at apex or base.

TREATMENT.—Bodily, mental, and general health.

DIAGNOSIS.—Etiological factor usually obvious. For exclusion of paroxysmal tachycardia, see below.

2. SIMPLE PAROXYSMAL TACHYCARDIA.

"Sudden acceleration of heart-rate in response to new impulses arising from a focus in the auricle removed from the normal pacemaker, viz., the sino-auricular node" (Lewis). A rare condition. The auricle and ventricle beat at the same rate. Is a regular series of premature systoles.

ETIOLOGY.—Occurs at all ages. Commoner in males. Previous rheumatic fever not infrequent.

Associated diseases.—Mitral stenosis most common. Often none.

At autopsy may be myocardial changes: nothing constant.

Simple Paroxysmal Tachycardia, *continued*.

FACTORS CAUSING ONSET.—(a) Exertion or emotion: usual cause. (b) Gastric disturbance, especially *flatulence*. (c) Rarely, influence of certain postures, e.g., bending.

CHARACTERISTICS.—

- a. Rate usually 140 to 190. *Rhythm regular*.
- b. Rate *unaffected* by exertion, emotion, alterations of posture, rest, or by atropine. Also *unaffected* by *digitalis*. Thus the new focus apparently is independent of ordinary nervous controls.
- c. Attack begins and ceases *abruptly*.
- d. Character of radial pulse-tracing: (i) Onset abrupt; (ii) Regular during paroxysm; (iii) Terminates suddenly; (iv) Subsequently a few slow beats, then rhythm faster than normal and showing extrasystoles.
- e. Electrocardiogram: During paroxysm, inversion of P in Leads II and III, or may be fused with QRS. Ventricular complex normal (Stimulus arises at abnormal focus.) Auricles and ventricles beat at same rate.

DURATION.—From a few seconds upwards, but rarely exceeds two weeks.

SYMPTOMS.—In short attacks (seconds or minutes), may be none. In longer attacks, severity of symptoms varies with (a) duration of paroxysm, (b) rate of beat, and also with (c) previous condition of heart, and (d) excitability of nervous system. In given individuals, successive paroxysms are in general similar in duration, type, and symptoms.

AT ONSET.—Various cardiac discomforts, from 'fluttering' to palpitation, with faintness, dyspnoea, precordial discomfort. Pale and sweating.

AS PAROXYSM PROGRESSES.—(a) 'Anginal symptoms'; all degrees to severest angina pectoris. (b) Gastric symptoms; especially flatulence, nausea, and vomiting. (c) Symptoms of cardiac failure (in prolonged attacks): heart dilates rapidly; veins engorged; pulmonary congestion; liver enlarged and tender; finally œdema.

TERMINATION.—

- a. **SUDDEN TERMINATION AND RAPID RELIEF.**—The usual result, even with cardiac failure. Rapid recovery. Often much flatus or urine passed.

Rarely fatal from:—

- b. Progressive cardiac failure.
- c. Sudden death. Rare.

DIAGNOSIS.—From:—

- a. **SIMPLE TACHYCARDIA.**—Pulse usually over 160, rate not affected by exertion, posture, etc.
- b. **AURICULAR FIBRILLATION.**—Rhythm regular.
- c. **AURICULAR FLUTTER.**—By duration, venous pulse tracing, and electrocardiogram.

Rapid pulse, vomiting, and abdominal pain have simulated perforated ulcer.

During quiescent periods, usually, occasional extrasystoles.

PROGNOSIS.—Good, as regards life, if no symptoms or signs of heart disease between attacks.

General prognosis varies with : (a) Frequency, and (b) Duration of attacks ; (c) Rate during paroxysm ; (d) Response to exertion (reserve power of heart) ; (e) Age : children and young adults may 'grow out' of attacks.

During a paroxysm, prognosis varies with : (a) Previous history ; (b) Duration of attack ; (c) Symptoms of cardiac failure—a serious sign, but recovery may occur at any point.

TREATMENT.—Symptomatic. For cardiac failure, usual remedies : rest, oxygen, morphia, venesection. Digitalis ineffective.

Attack sometimes terminated by pressure on the left vagus in the neck ; occasionally by vomiting, or by some posture ascertained by patient.

Prophylaxis important : Avoid sudden exertion and exciting causes. Firm abdominal binder may be effective.

Nodal Tachycardia.—Impulses start from A-V node. *Electrocardiogram* : P wave inverted, may precede, follow, or be buried in QRS. Manifestations as in **AURICULAR TACHYCARDIA** above.

Ventricular Tachycardia.—Impulses start in ventricle. Ventricular rate about 180, auricular rate about 80. Occurs in : coronary thrombosis, bundle branch block, overdosage with digitalis.

IV. BRADYCARDIA.

When the pulse-rate is diminished in frequency, consider :—

1. Are the rates of the pulse and heart-beat identical ?
2. Are the ventricles and auricles contracting at the same rate ?

VARIETIES OF BRADYCARDIA.—

1. **SIMPLE BRADYCARDIA.**—All chambers contracting at same rate. Regular. Rate rarely under 40.
2. **MISSED BEATS.**—Extrasystoles not reaching radial pulse. (*See EXTRASYSTOLES*, p. 780.)
3. **HEART-BLOCK**, partial or complete.—Auricle and ventricle beating at different rhythms. Usual cause of *regular* pulse under 35. (*See HEART-BLOCK*, p. 788.)

SIMPLE BRADYCARDIA.

1. **PHYSIOLOGICAL.**—Especially in tall athletic men. Also pulse slows with age.
2. **CONVALESCENCE FROM FEVERS.**
3. **MYOCARDIAL CHANGES.**—Fatty and fibroid hearts.
4. **INCREASED INTRACRANIAL PRESSURE.**—E.g., cerebral tumours, apoplexy.
5. **HYPOTHYROIDISM.**
6. **TOXIC.**—Digitalis. Uræmia (possibly increased intracranial pressure). Jaundice.

Simple Bradycardia, *continued*.

7. **VAGUS CONDITIONS.**—Rarely, pressure of tumours, etc., on vagus trunk. Vagus neuritis may be cause of certain forms, e.g., diphtheria, influenza.

Less important or constant: Pregnancy. Exhaustion. Hysteria and neuroses. Anæmia.

Action of Atropine.—Atropine paralyses vagus nerve-endings, and will thus differentiate extracardial (e.g., cerebral) and intracardial forms (e.g., heart-block, myocarditis). In former group injection of atropine quickens heart; in latter group it has slight or no effect.

V. SINUS ARRHYTHMIA.

Pulse periodically quickens and slows during inspiration and expiration: due to alteration in vagal tone with respiration. Common in young subjects during convalescence.

Characteristics.—(1) Rate of contractions alternately increases and diminishes: due to variation in length of diastole. (2) Beats are of equal strength. (3) Jugular and radial pulse-tracings show similar changes. Disappears when pulse-rate increases.

Prognosis.—Condition of no importance. Therefore must be distinguished from other types.

VI. EXTRASYSTOLES.

(*Premature Contractions.*)

A response of the heart to a stimulus from some abnormal focus arising before the normal impulse is due.

Etiology.—Especially in elderly men, but occurs at all ages.

ASSOCIATED DISEASES.—Severe cardiac conditions frequent.

1. **RHEUMATIC CONDITIONS.**—E.g., mitral stenosis. Previous rheumatic fever in one-third of all cases.

2. **MYOCARDIAL CHANGES.**—Hypertrophy or dilatation without valvular lesions.

3. **ARTERIOSCLEROTIC GROUP, CHRONIC NEPHRITIS.**—Especially in ventricular extrasystoles.

4. **ACUTE INFECTIONS.**—E.g., diphtheria, acute rheumatism.

Occasionally.—Pregnancy. Excessive tobacco. Digitalis.

No recognizable factor in many cases: subjects healthy.

Morbid Anatomy.—No special changes.

Frequency of Extrasystoles in liable subjects:—

DIMINISHED.—By increased rapidity of pulse—i.e., fever, exertion; pressure on abdomen.

INCREASED.—By exhaustion, dyspepsia, tobacco; by standing; by suspending respiration.

Nature of Extrasystoles.—The extrasystole is a premature contraction of the ventricle, and maybe also of the auricle, in response to a stimulus from some abnormal focus. Note:—

1. The stimulus may arise from various portions of the junctional tissues, producing *various types of extrasystoles*.

2. The stimulus may recur : (a) Irregularly ('intermittent') ; (b) Regularly—e.g., every 4th, 3rd, or 2nd beat (pulsus bigeminus)—producing 'grouped beats', a regular irregularity.
3. *The radial pulse.* The extrasystole is usually a small contraction, and frequently does not reach wrist. Hence radial pulse slower than apex beat. May be regular, if extrasystoles regular. Irregularity depends on : (a) Extrasystoles not reaching wrist (some or all). (b) Rhythm of the extrasystoles : (i) Intermittent—pulse irregular ; (ii) 'Grouped beats'.

Types of Extrasystoles.—

1. **VENTRICULAR EXTRASYSTOLE.**—Most frequent. Abnormal stimulus arises in ventricular wall or tissue ; ventricle contracts in response, auricle continuing its normal rhythm.

CYCLE OF VENTRICULAR CONTRACTIONS.—(a) Normal beat ; (b) Extrasystole—at interval shorter than normal ; (c) Long 'compensatory pause', (d) Normal beat, usually a 'big beat', stronger than normal Cycle of auricular contractions unchanged

Explanation of 'compensatory pause' : A stimulus arrives from normal focus (sino-auricular node) while ventricle is in 'refractory period', and it fails to respond ; hence no contraction until succeeding normal stimulus.

VENTRICULAR CONTRACTIONS.—Interval between the two normal beats is *exactly two normal periods*, with the extrasystole intervening.

VENOUS PULSE TRACING.—(a) Position of A wave shows normal auricular rhythm ; (b) Abnormal C wave, corresponding to ventricular extrasystole.

Note.—The ventricular extrasystole often closely coincides with the normal auricular systole, producing a *shock in cervical veins* and large A wave.

ELECTROCARDIOGRAM OF EXTRASYSTOLE.—P normal. Ventricular complex : Normal duration, but premature and abnormal in form : (1) Arising in basal or right portion of ventricle : Lead I—upward tall pointed deflection with downward broad deflection. Lead III—initial downward deflection. (2) In apical or left portion : Lead I—downward deep pointed deflection with upward broad deflection ; Lead III—initial upward deflection. Deflections biphasic. T wave may be inverted

2. **AURICULAR EXTRASYSTOLE.**—Abnormal stimulus arises in auricular tissue ; hence both auricle and ventricle contract.

CYCLE OF AURICULAR CONTRACTIONS.—(a) Normal beat ; (b) Extrasystole—at interval shorter than normal ; (c) Interval of normal length*—no 'refractory period' and 'compensatory pause' occurring ; (d) Normal beat. Cycle of ventricular contractions similar to auricle.

* May be slightly prolonged.

Auricular Extrasystoles, continued.

VENTRICULAR CONTRACTIONS.—Interval between the two normal beats is *less than two normal periods*, with the extrasystole intervening.

VENOUS PULSE TRACING.—(a) Abnormal A wave present—A waves in similar cycle to ventricular upstrokes; (b) Waves C and V follow the extrasystole A wave in normal sequence. (Rarely, the auricular extrasystole and (previous) normal ventricular systole coincide, producing a large V wave.)

ELECTROCARDIOGRAM OF EXTRASYSTOLE.—Starts with abnormal P wave—inverted, biphasic, or different size to others, especially in Leads II and III.

3. **NODAL EXTRASYSTOLE.**—Very rare. Stimulus arises in a site whence it spreads to both auricle and ventricle, which contract simultaneously.

General Characteristics.—

1. **RADIAL PULSE IRREGULAR.**—Various types.
2. **RATES OF PULSE AND APEX DIFFER.**
3. **SYMPTOMS.**—May be none. Commonly: (a) 'Compensatory pause' felt as a void in chest; (b) 'Big beat' felt as 'palpitation', with its usual phenomena. The extrasystole itself is not recognized.
4. **PHYSICAL SIGNS.**—*Palpation*: Extrasystole usually palpable at apex. *Auscultation*: Extrasystole accompanied by faint first sound (or murmur if incompetence); occurrence of second sound depends on whether extrasystole lifts the semilunar valves—often absent. Presystolic murmur never occurs.
5. **ELECTROCARDIOGRAM.**—Shows stimulus arises in abnormal focus.

Prognosis.—

1. Serious cardiac disease often present; prognosis little influenced by extrasystoles.
2. In absence of obvious cardiac disease, note:—
 - a. Extrasystoles may, not infrequently, continue to healthy old age. In infections and similar groups may disappear.
 - b. Increased work on heart and circulation is negligible.
 - c. Auricular fibrillation and the more serious irregularities are frequently preceded by periods of extrasystoles: but they are sequels only to a *small proportion* of extrasystoles.

CONCLUSIONS.—Extrasystoles *per se* are not indications for alteration in the patient's life, but are indications for regular examination for more serious conditions.

Diagnosis.—From: heart-block; slow auricular fibrillation.

Treatment.—Treat any causal factor (e.g., tobacco). Bromides if patient is nervous. Digitalis contra-indicated.

VII. AURICULAR FLUTTER.

A condition in which the auricle contracts regularly at a rate of 200 to 350, and ventricular contractions respond only to a certain proportion of the auricular stimuli, often to a half.

Mechanism: The 'Circus Movement' of Auricular Flutter and Fibrillation.—Normal stimulus causing cardiac contraction commences at sino-auricular node. It may be regarded as dividing into two main waves of excitation which pass round the superior vena cava and meet on the further side of the inferior vena cava; behind each wave is a zone of 'refractory' muscle; when the waves meet, the union of the two refractory zones ends the stimulus 'like the meeting of two prairie fires'. From these main waves, stimuli spread through the auricular musculature like 'the ripple on the surface of a pond into which a pebble is thrown'; they regather at the auriculo-ventricular bundles, and pass to the ventricles.

Phenomena of *auricular flutter* may be summarized thus:—

1. One main wave, possibly in consequence of increased rate or myocardial degeneration, meets a zone 'refractory' from previous stimulus, and can proceed no further.
2. The second main wave is not blocked: on completion of normal course, the muscle ahead is not 'refractory' (as it is normally), and hence the wave can proceed along the course normally followed, but in the reverse direction, by the other main wave. The zone which blocked the first wave has now recovered excitability. Hence this second wave completes the circuit to its starting-point.
3. But further—there is nothing to impede its entry on a second circuit. The 'circus movement' is thus established, and the same stimulus travels endlessly round the course.
4. As this wave travels, it spreads, like the normal wave, through the musculature of the auricle, and provokes contractions—usually 300 per minute.

Phenomena of *auricular fibrillation* are very similar. A similar 'circus movement' is occurring. Differences are:—

1. Rate is much greater—about 450 to 600 per minute.
2. The path is shorter—close to the orifices of the veins.
3. The zone of excitable muscle which the wave enters is in a state of 'partial refractoriness', some fibres being still refractory; and the amount of such 'partial refractoriness' varies in successive circuits.
4. Through this zone the wave chooses the path of least resistance, viz., the most excitable and least 'partially refractory' muscle fibres. Hence its path is zigzag and irregular. It thus differs from 'flutter', in which the zone is completely excitable (or almost so) and the wave proceeds directly and regularly. The secondary ripples similarly have an irregular path.

Auricular Flutter—Mechanism, continued.

This striking explanation supersedes the former hypothesis that numerous stimuli were produced at irregular auricular foci.

The zone of excitable muscle or 'gap' which the wave of excitation enters is very narrow, remainder of circle being in refractory state. Circus movement will cease if this gap can be closed, either by (1) lengthening refractory period of muscle, or (2) increasing the conductivity, i.e., rate at which wave advances: in either case wave would thus meet muscle still refractory, and stimulus comes to an end. This is sometimes effected by quinidine (see p. 787).

Relation to Certain Other Irregularities.—Closely connected with auricular fibrillation. From simple paroxysmal tachycardia, is separated arbitrarily by auricular rate exceeding 200: distinction justified by different symptomatology and result of treatment.

Etiology.—Mainly in elderly males. Associated with: (1) Arteriosclerosis: most commonly. (2) Rheumatic history: about 25 per cent. (3) Acute infections. (4) Syphilis: occasionally.

Morbid Anatomy.—Doubtful; probably fibrosis of myocardium.

General Description.

1. **AURICLE.**—Contracts *regularly*; rate 200 to 350; recognized by venous tracings or electrocardiogram.

2. **VENTRICLE.**—

a. *Heart-block* almost invariable; *usually* 2 : 1 *rhythm*.

b. Rate unaffected by exertion or rest: thus differing from healthy rapid ventricular rhythms.

Less often 4 : 1 and other rhythms, or mixed rhythms producing irregular slow pulses: converted at once to 2 : 1 rhythm by slight exertion. May be complete block.

Rarely ventricle beats at rate of auricle (ventricular flutter): only transient attacks compatible with life.

Pressure on left vagus or carotid causes transient slowing.

3. **GENERAL EFFECT ON HEART.**—Condition usually fair: no great dilatation. Ventricular output per beat may be small.

4. **DURATION.**—May be years.

Physical Signs.—(May be also valvular lesion.)

RADIAL PULSE.—(1) Usually 2 : 1 heart-block; *pulse rapid*; 120 to 160, *regular* in time, also in force, or may be *pulsus alternans*. Less commonly: (2) 4 : 1 heart-block, etc., or rhythm varying; pulse slower, irregular in time and in force. (3) Complete heart-block; pulse very slow and regular.

VENOUS PULSATIONS.—Rapid in all forms.

VENOUS PULSE TRACINGS.—Numerous small 'a' (auricular) waves; larger 'c' and 'v' waves. Recognition often difficult.

ELECTROCARDIOGRAM.—In all forms shows: (1) Auricle is beating regularly; (2) Ventricular contraction is always response to an auricular stimulus—i.e., there are no extrasystoles. *Character:* (1) P deflections: (i) Rate rapid, usually 280 to 300. (ii) Regular. (iii) Abnormal in form: usually inverted: in Lead I small deflection, in II and III larger. (iv) 2 or 3 to each ventricular complex. (2) Ventricular complexes: Normal form, usually regular.

Symptoms.—Attacks of palpitation, usually sudden onset and cessation.

1. **WITHOUT OTHER SIGNS OF HEART DISEASE.**—Symptoms depend on small output of blood during rapid contractions—viz.: (a) Rapid exhaustion and shortness of breath on exertion. (b) Giddiness: fainting common.
2. **SUPERVENING IN CHRONIC HEART DISEASE.**—Symptoms accentuated, severe cardiac failure occurs sooner or later. Effect on heart comparable with auricular fibrillation, but rarely so severe.

Diagnosis and Characteristics.—

1. **VENTRICULAR RATE RAPID.**—(a) Rapid, regular pulse, 120 to 160, in elderly persons. (b) Unaffected by rest or exertion. (c) Under digitalis: slower and irregular. (d) Heart-block almost invariably present—usually 2:1.
2. **VENTRICULAR RATE SLOW.**—Complete or high partial heart-block. Pulse often irregular. Symptoms slight. Diagnosis often missed or impossible without electrocardiogram.

Prognosis.—Depends on associated lesions and reaction to digitalis.

Treatment.—*Digitalis* specifically indicated (for dosage, see p. 825).

RESULT OF DIGITALIS TREATMENT.—(1) First, *slows pulse, auricle, and ventricle.* (2) Next, *converts flutter into fibrillation; pulse irregular.* (3) Finally, digitalis is stopped: fibrillation ceases and normal rhythm is resumed. Symptoms of failure, if present, improve rapidly. Repeat digitalis if flutter returns. If normal rhythm not restored, keep pulse-rate 60–90 by digitalis, and give quinidine.

VIII. AURICULAR FIBRILLATION.

A condition in which individual fibres or groups of fibres of the auricle contract rapidly and independently of each other. The auricle remains permanently in position of diastole, output of blood is slight, and the irregularity of passage of stimuli results in complete irregularity of ventricular contractions.

Mechanism.—See AURICULAR FLUTTER.

Etiology.—

AGE.—Two groups: (1) Rheumatic, age 10 to 50; sexes equal. (2) Non-rheumatic, age 40 to 80; commoner in males.

Auricular Fibrillation—Etiology, continued.

ASSOCIATED DISEASES.—(1) *Predominant is mitral stenosis.*

(2) Rheumatic history without mitral stenosis. (3) Elderly group with arteriosclerotic and myocardial changes. (4) In course of exophthalmic goitre. (5) Acute infections.

Morbid Anatomy.—Usually fibrosis of myocardium, especially in auricles: definite relation yet unproved. Generally valvular lesions, hypertrophy, and dilatation.

General Description and Results.—

1. **AURICLE.**—When experimentally produced in animals by faradization: auricle permanently in condition of diastole, fine fibrillating movements visible incessantly in walls.

2. **EFFECT ON VENTRICLES.**—Contractions *totally irregular in time and force*: owing to irregularity of stimuli emerging from auricles, also influenced in rate by impaired conductivity of junctional tissues by coexisting disease. Is essential cause of rapid irregular 'mitral' pulse.

3. **GENERAL EFFECT ON HEART.**—Great additional work leads to dilatation: usually slowly, but in rare paroxysmal fibrillation may occur in few hours.

4. **CARDIAC FAILURE.**—Follows from above effects.

5. **DURATION.**—When established, usually permanent until death.

PAROXYSMAL FIBRILLATION.—Rarely attacks are transient. Differs from 'simple paroxysmal tachycardia' only by irregularity of ventricular contractions. Often become permanent.

Physical Signs.—Depend on two factors: (1) Irregularity of ventricular contractions; (2) Absence of auricular contractions.

VENTRICLE.—Complete irregularity in time and force.

AURICLE.—In *mitral stenosis*: (a) *Presystolic murmur disappears* (no auricular systole). (b) Diastolic murmur frequently remains (due to ventricular diastole—see **CARDIAC SOUNDS AND MURMURS**): can be timed in long pauses.

PULSE.—*Rapid*, 100 to 160; complete irregularity; many beats fail to reach wrist. (*Very rarely*: Slow and almost regular, recognition of condition by tracings only.)

PALPITATION.—Apex beat forcible; may be diastolic thrill.

VENOUS PULSE TRACING.—Auricular 'a' wave absent. Ventricular contractions produce waves. Occasionally, fine oscillations due to auricular contractions. Interpretations difficult when great rapidity.

ELECTROCARDIOGRAM.—(1) P deflections absent. (2) Ventricular complexes: (i) totally irregular; (ii) amplitude varies without relation to length of preceding pause; (iii) usually of normal form. (3) Small oscillations due to auricle at about 150 per minute. (May also be ventricular extrasystole and lesions of a bundle-branch.)

Symptoms.—No symptoms special to auricular fibrillation. May be consciousness of irregularity. Commonly, *usual symptoms of cardiac weakness* (angina rare). Occasionally, no symptoms, especially when ventricle beats slowly.

Diagnosis.—Of cases of cardiac failure, 60 to 70 per cent are associated with auricular fibrillation. Is the common cause of *rapid irregularity*, pathognomonic in mitral stenosis with loss of presystolic murmur.

Note.—Slow irregular pulse, and diastolic murmur maximal at apex, is auricular fibrillation and not aortic regurgitation.

Prognosis.—Serious. Depends on: (1) Coexisting disease; (2) Severity of associated symptoms, considering the duration of the arrhythmia; (3) Rate of ventricle apart from treatment; (4) Reaction to digitalis, in rate and in symptoms. Great enlargement unfavourable.

DEATH.—Usually as in cardiac failure. Occasionally sudden: probably ventricular fibrillation.

Treatment.—Rest and *digitalis*. Digitalis is specifically indicated. Action: blocks impulses at auriculo-ventricular junction, and thus *slows ventricle*; auricular fibrillation remains. Quinidine sometimes restores normal rhythm.

1. **DIGITALIS.**—For dosage and method of administration, *see* p. 825.

2. **QUINIDINE: EFFECTS IN AURICULAR FIBRILLATION** (Hoffmann, Lewis).—This drug in some cases restores normal rhythm.

MODE OF ACTION (Lewis).—(1) *Lengthens refractory period.* This ends circus movement and restores normal rhythm. But it also: (2) *Slows conduction*: if this action equals or is greater than last, circus movement continues: accounts for failure in 50 per cent of cases. But it always slows *auricular rate*.

RESULTS OF ADMINISTRATION.—Two groups of cases, about equal number:—

1. *No effect on ventricular rhythm.* Cases with cardiac failure, or which do not respond to digitalis, are not corrected by quinidine: also many others.

2. *Rhythm becomes normal.* Note:—

a. Ventricular rate increases as auricular rate slows. Due to (i) lesser grade of heart-block, (ii) quinidine partially paralyzes vagus.

b. Relapses may occur on ceasing quinidine: controlled on further administration.

DOSAGE.—In gelatin capsules. *Initial dose*: gr. iij, to test sensibility. *Ill-effects*: headache, nausea, diarrhoea, sweating, rash. *Subsequently*: gr. vj, four doses daily for 4 to 7 days. If rhythm not regular, useless to continue. If regular, continue gr. v, daily over long period.

CONTRA-INDICATIONS.—Cardiac failure, myocarditis, heart-block, recent emboli.

GENERAL CLINICAL EFFECTS.—

1. Ventricular rate is usually increased when normal rhythm is restored.

Auricular Fibrillation—Treatment—Quinidine, *continued*.

2. Embolism may occur, from clots driven from auricular appendix on restoration of auricular contraction.
3. Clinical condition and comfort of patient show little improvement on restoration of normal rhythm.

CONCLUSION.—Quinidine should be used with caution. A course of digitalis should precede administration.

3. **PATIENT CONVALESCENT, OR Milder FORMS.**—Tincture of digitalis, \mathbb{M} v to x, t.d.s., over prolonged periods : larger doses may be necessary.
4. **GENERAL TREATMENT.**—Rest. Avoid all exertion. Attend to general health.
5. **HYPERTHYROIDISM.**—Auricular fibrillation, once established, is not controlled permanently without thyroidectomy.

General Characteristics.—

1. Usual cause of rapid irregular pulse
2. Common in severe cardiac failure.
3. Mitral stenosis often present : no presystolic murmur.
4. Markedly affected by digitalis, and often by quinidine.
5. Prognosis serious, but may live several years.

IX. HEART-BLOCK.

(Including Stokes-Adams' Disease.)

A condition in which impairment of conduction of stimuli from auricle to ventricle finally results in ventricle contracting less frequently than auricle.

Note.—This section refers to auriculo-ventricular block. For sino-auricular block, see p. 791.

Etiology.—Commoner in males. Occurs at all ages (in young, rheumatic ; in old, syphilitic).

CAUSAL CONDITIONS.—

1. **RHEUMATIC FEVER.**—(a) Acute stages : rare, and transient.
(b) Chronic form : *usual cause* (may be associated with mitral stenosis, auricular fibrillation, extrasystoles).
 2. **FIBROID MYOCARDITIS.**—Origin may be : (a) Arteriosclerosis ; (b) Syphilis.
 3. **DRUGS.**—Overdosage with digitalis, quinidine, strophanthus.
- Less common :—
4. **SEVERE FORMS OF ACUTE INFECTIONS.**—Enteric, diphtheria, influenza, sepsis ; others rarely.
 5. **TUMOURS OF BUNDLE OF HIS.**—Rare. May be gumma.
 6. **CONGENITAL**—Defect interrupting bundle of His, e.g., patent interventricular septum.

Morbid Anatomy.—Connecting auriculoventricular tissue always affected, usually *main bundle of His*.

LESION.—(1) In acute infections, leucocytic infiltration. (2) In chronic conditions, fibrosis or calcification ; this often spreads from the 'central fibrous body' below which the bundle passes. General myocarditis usually is present. (3) Gummata, tumours.

Types of Heart-block.—(1) Partial; (2) Complete; (3) Bundle-branch.

1. **PARTIAL HEART-BLOCK.**—The contractions of the ventricle result from stimuli arriving from auricle. Varieties and progressive degrees :—

a. **PROLONGED A-V INTERVAL**, but all stimuli pass, and ventricle and auricle beat at same rate. Recognized by long P-R interval (exceeding normal 0.2 sec.) and long A-C interval in jugular pulse tracings.

Physical Signs (difficult).—In mitral stenosis, interval between presystolic murmur and first sound. If no murmur, may be reduplication.

b. **OCCASIONAL 'DROPPED BEATS'.**—The ventricle fails to respond to a contraction of auricle (no pulse or *apex beat*). Preceded by progressive lengthening of A-C interval. Succeeded by short P-R and A-C interval and recurrence of cycle.

c. **2 : 1 RHYTHM.**—Ventricle responds to alternate auricular contractions. Common in mitral stenosis.

Physical Signs.—In 2 : 1 rhythm, two thrills and two murmurs to each apex beat.

Rarely, 3 : 1 and 4 : 1 or other rhythm. Physical signs complex.

GENERAL CHARACTERISTICS.—

i. Radial pulse and apex beat show similar rate and irregularity.

ii. Rate commonly 40 to 50 : irregular or intermittent.

iii. Irregularity stopped by exertion ; often by atropine.

iv. Electrocardiogram shows auricle beating faster than ventricle.

v. Silence on auscultation during radial pauses.

ELECTROCARDIOGRAM.—P deflections : (i) regular and normal ; (ii) not always followed by ventricular complex, but (iii) ventricular complex always preceded by a P.

2. **COMPLETE HEART-BLOCK.**—The ventricle and auricle beat with independent rhythms, no effective stimuli reaching ventricle.

CHARACTERISTICS.—

i. Radial pulse and apex beat show similar rate.

ii. Ventricular and pulse-rate very *slow*, 35 or less ; *regular*.

iii. Unaffected by exertion or atropine.

iv. Electrocardiogram shows ventricle beating slower than auricle (about 70), but rhythms independent.

v. Attacks of giddiness, etc.

PHYSICAL SIGNS.—

Pulsations in cervical veins ; obviously more rapid than apex beat ; also of varying strength—e.g., *big wave* when auricle and ventricle contract *simultaneously*.

Heart-sounds, though regular, *vary in loudness* and may be reduplicated—depending on coincidence of contraction of auricle and ventricle.

Heart-block—Complete, continued.

ELECTROCARDIOGRAM.—(1) P deflections regular and normal.

(2) Ventricular deflections regular and normal, but less frequent than P, and without time relations to P.

3. BUNDLE-BRANCH BLOCK.—Block occurring below bifurcation of auriculoventricular bundle, either right or left branch. No recognizable symptoms or physical signs: recognition by electrocardiogram only. Prognosis very bad.

When right branch involved, stimulus for contraction travels from auricle to both ventricles along left branch alone, and vice versa for left branch.

ELECTROCARDIOGRAM.—(1) P normal and precedes each ventricular complex. (2) Ventricular complex: Abnormal; amplitude increased, of longer duration, and is diphasic (two deflections only).

Right Branch.—In Lead I: R' tall and broad. In Lead III: S' deep and broad. Resembles left-sided predominance, but in branch-block T' and R' point in opposite directions.

Left Branch.—In Lead I: S' deep and broad. In Lead III: R' tall and broad. Resembles right-sided predominance.

Attacks of Heart-block.—Heart-block thus occurs in all grades, from slight partial forms to complete. In the usual chronic conditions of impaired conductivity, some varying degree of partial block (e.g., dropped beats) is constant or almost constant, while *attacks* occur of severer partial or of complete block of variable duration. Note that definite cardiac disease productive of symptoms is also practically always present—e.g., mitral stenosis, fibroid myocarditis. *Danger* arises from:—

1. Concomitant cardiac disease.
2. Period of transition from partial to complete block.
3. Periods of excessive slowing of ventricular contractions.

Symptoms.—

1. THOSE OF ASSOCIATED DISEASE—e.g., mitral stenosis.
2. THOSE ARISING DIRECTLY FROM HEART-BLOCK.—
 - a. GENERAL CIRCULATORY DISTURBANCES.—As in other cardiac disease, arising from degree of heart-block constantly present. Usually slight, being compensated by ventricular hypertrophy, *if* no associated disease is present.
 - b. ANÆMIA OF THE BRAIN.—Produces characteristic results. Arises in one of two ways: (i) In complete or severe partial blocks, periods occur of further excessive slowing or of ventricular asystole; pulse-rate 7 to 30; cause unknown (auricular rate unchanged). (ii) At onset of complete heart-block, a period of ventricular asystole occurs before independent ventricular rhythm commences.

Symptoms:—

Minor degrees: pallor, giddiness.

Unconsciousness usual if: (1) Rate below 20; (2) Asystole 3 to 7 seconds.

Convulsions, if asystole 15 seconds. Face, upper limbs; rarely general. Also cyanosis, congestion, respiration deep and irregular. No micturition or biting tongue. May be repeated attacks, and death in 'status epilepticus'.

Stokes-Adams' Disease.—Applied to syndrome, as above, of (1) *heart-block*, (2) *convulsions*. Excludes numerous heart-blocks without convulsions. Consists of the severe heart-blocks with temporary excessive slowing or prolonged ventricular asystole.

Prognosis of Heart-block.—Heart-block is proof of, and prognosis depends on extent of, myocardial disease. Consider: (1) Condition of heart (bad in mitral disease); (2) General cardiac symptoms; (3) Frequency, duration, and severity of syncopal attacks or convulsions.

In chronic forms, prognosis always serious. *Death* occurs from: (a) General cardiac failure—commonly; (b) *Suddenly*—from prolonged asystole of 1 to 2 minutes (viz., onset of complete block); (c) *In status epilepticus*.

In acute febrile group, prognosis during illness worse, but attacks may subsequently cease permanently.

Diagnosis.—From extrasystoles (audible at apex).

Treatment.—

IN CHRONIC FORMS.—Bed not essential.

MILD DEGREES.—No special treatment. Digitalis not contra-indicated, though may increase degree of block.

ATTACKS OF HIGH GRADE.—Rest in bed. Treat cause (rheumatism, syphilis).

CONVULSIONS.—No treatment effective. Lie down at warning symptoms, e.g., flatulence. Inject adrenalin, 1-1000, $\text{M}\times$.

SINO-AURICULAR BLOCK.

(*Tortoise Heart*.)

Whole heart misses a beat. Succeeding beat normal. Every other beat may be missed, heart-rate about 30. Exercise or injection of atropine may restore normal rhythm. Cause uncertain, may be vagal: occasionally produced by digitalis. No clinical importance.

X. PULSUS ALTERNANS.

A condition in which ventricular beats are alternately strong and weak, although the rhythm is regular. Its importance is the seriousness of the ultimate prognosis.

Auricle and ventricle beat regularly: sequence of contraction normal. Condition is ascribed to impaired function of contractility.

Occurrence.—Two groups:—

1. **SEVERE TACHYCARDIA**—e.g., auricular flutter. Importance in prognosis slight.

Pulsus Alterans—Occurrence, *continued*.

2. NORMAL HEART-RATE.—

- a. In group of myocardial disease, angina, chronic nephritis. Usually in later life. Most frequently following an extrasystole. *Prognosis*: extremely serious; life rarely exceeds two years, even when rhythm occurs for a few beats only.
- b. May occur during digitalis administration. *Omit instantly*.

Diagnosis.—Distinguished from regular extrasystoles (pulsus bigeminus) by normal cycle. No special symptoms. Rarely recognizable by finger. In cases of Group 2 a, should be carefully looked for in electrocardiogram, especially following an extrasystole.

Treatment.—Rest. Avoid all strain.

CHAPTER CXLV.

AFFECTIONS OF THE MYOCARDIUM.

I. HYPERTROPHY.

Hypertrophy is the response of the heart to chronic demand for extra work. Results from: (1) Organic cardiac disease, valvular or myocardial; (2) Pulmonary disease; (3) Increased blood-pressure. When hypertrophy reaches its limit and demand continues, dilatation proceeds and cardiac insufficiency occurs.

Morbid Anatomy.—

MACROSCOPIC.—Two types described: (1) Eccentric; cavity normal or enlarged; wall thickened: hence heart enlarged. (2) Concentric; cavity smaller than normal (is a post-mortem effect).

MICROSCOPIC.—Muscle fibres increased in length and breadth. Number probably never increased.

Hypertrophy of Left Ventricle.—

CAUSES.—

1. LOCAL CONDITIONS OF HEART.—(a) Valvular lesions: aortic lesions, mitral incompetence. (b) Fibroid myocarditis. (c) Pericardial adhesions—to *extracardial* tissues.
 2. HYPERTENSION AND ARTERIOSCLEROSIS.
 3. THYROTOXICOSIS.
- Rare conditions: stenosis or coarctation of trunk of aorta. Possibly prolonged muscular exertion.

Note:—

1. Hypertrophy of other chambers occurs subsequently.
2. Greatest hypertrophy: in pericardial adhesions (20 to 40 oz.), aortic incompetence.
3. Hypertrophy with minimum of dilatation: in aortic stenosis, chronic nephritis.
4. Valvular lesions act mainly by increased intracardial pressure.

SYMPTOMS.—Often none during compensation. Occasionally: giddiness, flashes of light, headache, failing memory, shortness of breath.

PHYSICAL SIGNS.—Definite. (1) Apex beat displaced *downwards* (6th space). (2) Impulse forcible and heaving. (3) At apex, first sound *booming*. (4) At pulmonary area, second sound accentuated. Pulse, full. Blood-pressure, raised.

Hypertrophy of Right Ventricle.—

CAUSES.—

1. CONDITIONS INCREASING PULMONARY PRESSURE.—(a) Mitral valve lesions. (b) Chronic lung diseases—e.g., emphysema, fibrosis, bronchitis.

2. In latter stages of: (c) Pericardial adhesions; valvular disease of left side.

3. Right valvular lesions. Rare.

PHYSICAL SIGNS (anterior surface of heart is almost entirely right ventricle).—(a) Systolic (positive) pulsation in epigastrium. (b) Apex beat diffuse (right ventricle) (c) Cardiac dullness increased to right. (d) Venous pulsation in neck marked; tricuspid first sound accentuated.

Hypertrophy of Auricles.—*Dilatation* invariably coexistent.

RIGHT AURICLE.—Increased pulmonary pressure. Usually follows right ventricle.

PHYSICAL SIGNS.—Dullness to right of sternum. Venous pulsation in neck.

LEFT AURICLE.—Mitral lesions. Suggested in mitral stenosis by loud presystolic murmur. Diagnosis by X rays only.

Electrocardiogram.—

RIGHT VENTRICLE PREDOMINANT.—Lead I: R small, S deep. Lead III: R tall, S small. *Viz.*, largest deflections point towards each other.

LEFT VENTRICLE PREDOMINANT.—Lead I: R tall, S small. Lead III: R small, S deep. *Viz.*, largest deflections point away from each other.

Note.—Both ventricles may be affected. In hypertrophy of auricles, P may be increased.

II. DILATATION.

Dilatation of the heart applies to enlargement of the chambers. Causes are: (1) Conditions which lead to overfilling of a chamber; (2) Conditions which weaken the walls. In general, causes are those of hypertrophy, dilatation resulting when hypertrophy reaches its limit and demand for further work continues unsatisfied: cardiac insufficiency thus develops.

Normally, a heart when increasing its rate shortens diastole; hence relaxation is less complete, and heart *becomes smaller*.

Etiology.—Two causal factors: (1) *Increased intracardial pressure*; (2) *Impaired resistance of cardiac muscle*. May coexist.

Dilatation of the Heart—Etiology, continued.**1. INCREASED INTRACARDIAL PRESSURE.—**

- a.* All *valve lesions*.
- b.* Right ventricle: pulmonary hypertension, e.g., mitral stenosis; emphysema, fibrosis; pulmonary arteriosclerosis (Ayerza's disease).
- c.* Acute dilatation from exertion—e.g., dilatation of right heart after sprinting. Recovery rapid: capacity for recovery increased by judicious 'training'.

2. IMPAIRMENT OF CARDIAC MUSCLE.—

- a.* Chronic myocarditis—e.g., fibrosis, fatty heart. Hypertrophy may have reached its limit, then dilatation proceeds uncompensated—e.g., in chronic nephritis.
- b.* Acute pericarditis: often serious.
- c.* Acute endocarditis.
- d.* Acute fevers: occasionally rapid death.
- e.* Pericardial adhesions—mechanical interference with muscle.
- f.* Anæmia—impaired nutrition of muscle.
- g.* Disturbances of rhythm—e.g., sometimes in paroxysmal tachycardia, auricular fibrillation.
- h.* Thyrotoxicosis.

Symptoms.—(As in cardiac failure.) Early: dyspnoea, palpitation, giddiness or fainting, precordial discomfort or pain.

Physical Signs.—*Pulse* rapid. Blood-pressure falls.

INSPECTION.—Apex beat displaced outwards: diffuse, weak. Wavy impulse.

PERCUSSION.—Cardiac dullness increased transversely.

AUSCULTATION.—First sound: short, sharp, and clear, often resembles second sound, or tic-tac rhythm. Sounds may be weak.

DILATED RIGHT VENTRICLE.—Pulmonary second sound loud; may be tricuspid systolic murmur.

III. DISEASES OF THE MYOCARDIUM.**Classification.—**

- 1. ACUTE LESIONS.**—(1) Acute myocarditis: (*a*) Parenchymatous degeneration; (*b*) Interstitial myocarditis. (2) Embolus and thrombosis of coronary arteries. (3) Ischæmic necrosis. (4) Septic infarcts.
- 2. CHRONIC LESIONS.**—(1) Chronic interstitial myocarditis (fibroid heart). (2) Fatty heart: (*a*) Fatty degeneration; (*b*) Fatty infiltration.
- 3. VARIOUS DEGENERATIONS.**—(1) Brown atrophy. (2) Fragmentation and segmentation. (3) Amyloid degeneration. (4) Zenker's degeneration. (5) Calcareous degeneration.

1. ACUTE LESIONS.

Acute Myocarditis—

ETIOLOGY.—(a) Acute fevers, especially *diphtheria*, influenza, typhoid, and sepsis. (b) *Acute rheumatic fever*. (c) Intoxications: e.g., in acidosis (as in eclampsia) parenchymatous degeneration often advanced.

VARIETIES AND MORBID ANATOMY.—

a. PARENCHYMATOUS DEGENERATION.—

Macroscopic: Pallor and softness of muscle.

Microscopic: Granular degeneration of muscle fibres

b. INTERSTITIAL MYOCARDITIS.—

Macroscopic: Nil.

Microscopic: Interstitial tissue infiltrated with small round cells and leucocytes, muscle fibres degenerated. Probably *chronic* interstitial myocarditis often follows.

Acute Rheumatic Fever.—Aschoff's nodes present (see p. 290): later become fibrous

SYMPTOMS.—Indefinite May be acute cardiac failure, as in diphtheria, with sudden or rapid death Affection of muscle suggested (e.g., in diphtheria) by: (a) Pulse feeble: easily accelerates. (b) Apex beat and heart-sounds feeble; may be soft apical systolic murmur. (c) Cardiac dullness slightly increased.

TREATMENT.—As in ACUTE ENDOCARDITIS (q v.)

2. Thrombosis of Coronary Artery.—See p. 834.

3. Ischæmic Necrosis (*Acute Necrosis or Softening, White Infarct*).

ETIOLOGY.—Sequel of coronary thrombosis.

MORBID ANATOMY.—

Macroscopic.—Irregular wedge-shaped yellowish area; projects above surface. Pericarditis on surface. Common site: left ventricle (anterior coronary artery).

Microscopic.—Necrosis of fibres, leucocytic infiltration, gradual fibrosis.

Aneurysm or rupture of heart may result: rare.

4. Septic Infarcts.—In pyæmia, septic emboli may result in multiple abscesses: may rupture into cavity or pericardium.

2. CHRONIC LESIONS.

1. Chronic Interstitial Myocarditis (*Fibroid Myocarditis, Fibroid Heart*).—

ETIOLOGY.—(1) *Disease of the coronary arteries is the predominant cause* of generalized form; (2) Arteriosclerosis and hypertension; (3) Syphilis.

MORBID ANATOMY.—

Macroscopic.—Muscle tough: hypertrophy usual. Frequently, patches of fatty degeneration under endocardium.

Microscopic.—Muscle fibres necrosed and degenerated: excess of fibrous tissue.

Condition most advanced at apex of left ventricle.

Chronic Interstitial Myocarditis, *continued*.

SYMPTOMATOLOGY.—Complex. Symptoms are due to cardiac insufficiency, or to abnormal rhythms resulting from fibrosis of stimulus-producing or junctional tissues (*see* DISTURBANCES OF THE CARDIAC CONTRACTIONS, p. 774).

a. LATENT.—May be no complaints, sudden death occurring.

b. INITIAL SYMPTOMS attracting attention:—

Shortness of Breath.—Most frequent. Slight, or all grades to 'cardiac asthma'.

Dizziness.—Attacks of syncope; *fainting and cold sweats*.

Headache. Flashes of light. Memory failing; grades of mental disorders up to (rarely) mania. Epigastric fullness.

Cardiac Pain.—From precordial pain to severest angina.

Extrasystoles.

Heart-block.—All grades to typical Stokes-Adams' disease.

c. SYMPTOMS OF GENERAL CARDIAC FAILURE.

PHYSICAL SIGNS.—Often indefinite.

PULSE.—Frequently slow, often irregular rhythm. Very variable, depending on: (*a*) Abnormal rhythms—extrasystoles, heart-block; (*b*) Dilatation—pulse rapid.

AUSCULTATION.—Mitral first sound roughened; aortic second sound accentuated.

ARTERIES.—Usually thickened, blood-pressure high.

ELECTROCARDIOGRAM.—Widening and notching of QRS; inversion of T waves.

2. **Fatty Heart.**—

a. FATTY DEGENERATION.—Common.

ETIOLOGY.—Occurs in: (i) Impaired nutrition: wasting; cachexia from any cause; old age. (ii) Pernicious anæmia: rapid and advanced. (iii) Phosphorus poisoning: rapid and advanced. Alcohol. (iv) With most myocardial changes in varying degree (acute infectious fevers, hypertrophy, myocarditis).

MORBID ANATOMY.—

Macroscopic.—Heart large, flabby, friable.

Microscopic.—Rows of fat globules within muscle fibres.

May be general or local, latter especially below endocardium. Left ventricle most affected.

SYMPTOMS.—As in chronic interstitial myocarditis. *Latency* common even with advanced changes: death from causal factor.

b. FATTY INFILTRATION.—Invariable in obesity.

MORBID ANATOMY.—

Macroscopic.—Fat accumulates first below pericardium, spreads through wall.

Microscopic.—Great masses of fat cells. Muscle fibres atrophied. Fatty degeneration frequently coexists.

SYMPTOMS.—Response to exertion limited ; pulse soft, regular ; heart-sounds faint. Usually no symptoms until dilatation and failure.

PROGNOSIS.—Consistent with long duration. May be sudden or rapid death.

3. VARIOUS DEGENERATIONS.

These are of little clinical importance.

1. **Brown Atrophy.**—Common in old age, chronic valvular disease. Heart tough, dark brown. *Microscopic:* Granules of brown pigment near nuclei of muscle fibres.
2. **Fragmentation and Segmentation of Muscle Fibres.**—Occasionally occurs with other myocardial changes.
3. **Amyloid Degeneration.**—Rare. Affects connective tissue.
4. **Zenker's Hyaline Degeneration.**—Mainly occurs in enteric fever.

CHAPTER CXLVI.

ENDOCARDITIS.

Inflammation of the lining membrane of the heart. Usually confined to the valves.

Classification.—Endocarditis may be: (1) Acute: (a) Simple; (b) Infective. (2) Chronic. All variations, especially between acute and chronic. Hence endocarditis is considered as follows:—

1. SIMPLE.—

a. **ACUTE.**—Characterized by vegetations on valves.

b. **CHRONIC.**—Fibrosis causing abnormalities of the valves:
(i) Secondary to simple acute endocarditis; (ii) Degenerative.

2. INFECTIVE.

Synonyms.—

SIMPLE.—Benign. Verrucose. Warty. Rheumatic.

INFECTIVE.—Malignant. Ulcerative. Septic. Subacute bacterial.

I. ACUTE SIMPLE ENDOCARDITIS.

Characterized by vegetations on the valves. Most common in childhood and young adults ; rare after 40 years.

Etiology.—Probably invariably secondary to some infection:—

- | | |
|--------------------------|---|
| 1. Acute rheumatic fever | } Group of rheumatic affections forming predominating cause of simple endocarditis. |
| 2. Chorea | |
| 3. Tonsillitis | |

Acute Simple Endocarditis—Etiology, continued.

Less commonly :—

4. Specific fevers : especially scarlet fever. Rarely diphtheria, pneumonia.

NOTES ON ABOVE CAUSES.—

1. *Acute Rheumatic Fever*.—Endocarditis occurs :—

In one-third to one-half of cases, at least.

More commonly in children, viz., under 20.

More commonly in first attack.

Without definite relation to severity of arthritis.

Early in attack : usually physical signs by second week.

Commonly affects mitral valve.

2. *Chorea*.—Usual cause of fatal acute endocarditis. In fatal chorea, almost invariable. Of non-fatal cases of chorea, half develop cardiac lesions.

5. *Pneumonia*.—Infective form commoner than simple.

6. *Phthisis*.—In 5 per cent of autopsies. Probably not due directly to *B. tuberculosis*. No clinical importance.

No evidence that syphilis causes acute endocarditis.

Recurrent endocarditis on old affected valves common.

FŒTAL ENDOCARDITIS.—Occurs with or without congenital abnormalities, in the former case being either cause or sequel.

Nearly always right side, especially pulmonary valves. Incidence here ascribed to : (1) Higher pressure in right ventricle ;

(2) Frequency of abnormalities ; (3) Infected blood from placenta.

CONGENITAL HEART DISEASE.—Liable to superimposed endocarditis

Morbid Anatomy.—**SITES AFFECTED.—**

1. Left heart in great majority. Ascribed to high blood-pressure. Possibly also greater oxygenation of blood.
2. Mitral valve commonest. From greater tension in closure of valve.

MACROSCOPIC.—*Minute vegetations on valves* : irregular warty appearance ; may have narrow pedicles. Occasionally larger cauliflower growths.

SITUATION.—At site of maximum closure, viz. : *Mitral valves* : on auricular surface, short distance from margin. *Aortic valves* : on ventricular surface, from corpora Arantii, following the lunules.

Hyperæmia of neighbouring endocardium rare.

HISTOLOGY.—(1) Earliest—degeneration of endothelium (nuclei fail to stain) ; (2) Then fibrin and leucocytes deposited from blood, forming 'vegetation' ; (3) 'Organization' into fibrous tissue follows, by proliferation of endothelial and subendothelial cells ; (4) Subsequent cap of fibrin and leucocytes. Micrococci common in fibrin or on surface.

SUBSEQUENT CHANGES.—May be either :—

1. **VEGETATIONS ABSORBED** and valve becomes normal (not proved).

2. **PROGRESSIVE FIBROSIS OF THE VALVE**, causing thickening, irregular contraction, and deformity: valves shorten, edges often adherent to each other. Chordæ tendineæ and papillary muscles affected and shortened. Deposition of lime salts. Such changes (chronic endocarditis) prevent function of valves, and constitute the danger of endocarditis.
3. **INFECTIVE ENDOCARDITIS** occasionally follows.
4. **RECURRENT ENDOCARDITIS**—Small recent vegetations on fibrosed valves.

MYOCARDITIS.—Commonly present. In rheumatic cases, Aschoff's nodes

Symptoms.—*None characteristic*: attack often latent and unrecognizable. *Most constant is fever*. Palpitation sometimes marked.

IN RHEUMATIC FEVER.—Suggested by: (1) Increased fever without increased arthritis, or (2) Persistence of fever after subsidence of arthritis; may be (3) Rapid pulse or irregularity; less often palpitation, cardiac pain (probably of myocardial origin). Rheumatic nodules often present

IN RECURRENT ENDOCARDITIS.—Often prolonged pyrexia, 100° to 102° F.

Physical Signs.—*Pulse rapid*.

INSPECTION.—Precordial impulse often increased and wavy. Apex beat displaced to left.

AUSCULTATION.—Earliest sign: slight roughening or prolongation of first sound: may increase (after several days) to faint murmur. Often reduplication and accentuation of pulmonary second sound.

In acute rheumatic fever, such murmur at apex (or sometimes maximum nearer sternum) is frequently mitral endocarditis; if basal, less definite evidence; if aortic diastolic, undoubted endocarditis.

Diagnosis.—Difficulty due to: (1) Absence of symptoms; (2) The fact that a murmur in fever is not proof of endocarditis. Note: (a) Pyrexia, in relation to arthritis or other cause (*see above*); (b) Auscultation; (c) Cardiac symptoms.

IF MURMUR PRESENT:—

1. Is it exocardial (*see p. 767*) or intracardial?
2. If intracardial, is endocarditis present? Note:—
 - a. Myocardial murmurs: Usually some *dilatation*, pulse rapid, and some irregularity, and often dyspnoea. Immediate diagnosis often impossible.
 - b. Hæmic murmurs: Soft and blowing, usually at base.
3. If endocarditis is present, is it recent, old, or recurrent? If old: often previous chorea or rheumatism, history of dyspnoea, etc., signs of hypertrophy or dilatation.

Complications.—Rarely cause symptoms.

MYOCARDITIS.—Some degree rarely absent; in rare severe grades, cardiac symptoms present with irregular pulse.

PERICARDITIS.—Not uncommon in children.

EMBOLI.—Uncommon in acute simple endocarditis.

Acute Simple Endocarditis, *continued*.

Course and Prognosis.—

1. IN ACUTE STAGE.—Death may occur: (a) In chorea; (b) Occasionally from pericarditis and myocarditis; (c) From rheumatic fever without other obvious cause (rare).

COURSE SUBSEQUENT TO ACUTE STAGE:—

- a. Symptoms and signs disappear; no recurrence.
- b. Symptoms disappear, physical signs remain. Often good health for years. Usually, after variable interval, recurrent attacks or cardiac failure.
2. REMOTE PROGNOSIS (impossible in acute stage).—Depends on: (a) Age: worse in children. (b) Degree of valvular affection and myocarditis. (c) Valves involved: aortic worse than mitral; serious if both valves. (d) Opportunities for rest; general health. Liability to recurrences of rheumatic fever important.

Treatment.—*Prolonged rest* is first essential. No treatment in rheumatic group prevents onset. Salicylates of no effect.

If present or suspected, e.g., in rheumatic fever: (1) Rest in bed, complete: two to three months at least. (2) Blisters, 1 in. diameter, over heart (liquor epispasticus).

Diet: Avoid meat and meat extracts.

Treat concomitant rheumatic fever.

Digitalis inadvisable except with certain irregularities of pulse.

If restlessness, give morphia.

Careful convalescence: Iron and arsenic tonic.

II. CHRONIC SIMPLE ENDOCARDITIS.

Sclerosis of the valves leading to various deformities, causing interference with function.

Etiology.—

1. INFLAMMATORY.—Sequel to acute endocarditis, especially rheumatic.
2. DEGENERATIVE.—(i) Arteriosclerosis and hypertension; (ii) Syphilis; (iii) Old age. Aortic valve affected. Mitral valve commonest, then aortic. Right side very rare. Many cases probably rheumatic, even when no history obtainable.

Morbid Anatomy.—

EARLY STAGE.—Valve slightly opaque and thickened, especially near edge at line of maximum closure. May be nodules, but no definite vegetations.

PROGRESS.—Fibrosis advances, tissue contracts: whence valves thickened and deformed, adherent to each other, edges curled.

RESULT IN AORTIC VALVES.—Incompetence, often without stenosis.

RESULT IN MITRAL VALVES.—(1) Valve ring affected and narrowed. (2) Lime salts deposit and form hard ring.

(3) Chordæ tendineæ affected—thicken, contract, and shorten : may be extreme. (4) Papillary muscles may fibrose. Hence, with incompetence, usually some grade of stenosis.

Acute endocarditis, with vegetations, often superimposed. Infective endocarditis not uncommon.

Symptoms, Physical Signs, etc.—See CHRONIC VALVULAR DISEASE, p. 804.

III. INFECTIVE ENDOCARDITIS.

(*Malignant or Ulcerative Endocarditis.*)

The condition is practically a septicæmia, with the focus in the heart. Manifestations vary widely. Characterized by : (1) General septicæmic and pyæmic symptoms ; (2) Emboli, with mechanical and suppurative effects ; (3) Locally in the heart, destruction of tissue and various signs and symptoms. Bacteria present in the blood.

For SUBACUTE BACTERIAL ENDOCARDITIS, see p. 803.

Etiology.—

PRIMARY.—No previous known injury of valves, and no obvious septic focus. Rare.

SECONDARY.—Almost always so : secondary either to :—

1. OLD SCLEROTIC VALVES—i.e., previous endocarditis—common form ; or to :—
2. SEPTIC FOCUS.—Common examples are : (a) Pneumonia ; (b) Osteomyelitis, otitis media ; (c) Specific fevers.

Rare in acute simple endocarditis of chorea and rheumatism. Not uncommon in congenital lesions.

Morbid Anatomy.—

IN THE HEART.—All gradations from simple endocarditis occur, but in definite cases :—

1. LOSS OF TISSUE IN VALVES.—Greater and of wider area than in simple form. *Results* : Aneurysm or perforation of valve ; rupture of chordæ tendineæ ; perforation of septum or, rarely, of heart.
2. THROMBUS FORMATION from blood on affected areas often marked.
3. MURAL ENDOCARDITIS more frequent than in simple form (often but not always in contact with valves).

Usual Sites : Left interventricular septum ; posterior wall of left auricle.

Changes result in fungating area with large vegetations readily detachable to form emboli.

ASSOCIATED LESIONS.—

1. FROM PRIMARY DISEASE—i.e., septicæmia, pneumonia, etc.
2. EMBOLI.—See SYMPTOMS. Frequent.
3. MYOCARDITIS.

Complications.—Pneumonia, pleurisy, pericarditis, meningitis : origin either embolic or septicæmic. Enlargement of spleen or liver, and nephritis, may occur from sepsis.

Infective Endocarditis, *continued*.

Bacteriology.—Blood cultures to be taken in all doubtful cases, presence of organisms constituting the only absolute proof of the disease. Commonest organism is a hæmolytic streptococcus. Others occurring are staphylococcus, pneumococcus, rarely *B. influenza*, gonococcus, and various other bacteria.

Clinical Types.—Various types are recognized according to predominating features: (1) *Septic*; (2) *Cardiac*; (3) *Typhoidal*, simulating typhoid; (4) *Cerebral*, simulating meningitis.

1. **SEPTIC.**—Characteristics: (a) Septic focus present. (b) Symptoms of septicæmia prominent: rigors, sweats, irregular pyrexia. (c) Cardiac symptoms not prominent: may be emboli. (d) *Duration*: rapid, few days.
2. **CARDIAC.**—Characteristics: (a) Severe pyrexia and endocarditis, usually with *previous chronic valvular disease*, commonly aortic. (b) Cardiac phenomena marked. (c) *Emboli* very common. Onset suggested by high fever, weakness, and anæmia, with cardiac physical signs varying frequently: proved by emboli and petechiæ. (d) *Duration*: may be prolonged, many months.

Symptoms and Physical Signs.—Very variable. Onset acute or insidious; but progress rapid with increasing debility, loss of weight, and rapid pulse. Referable to three classes: (1) *Septicæmia*; (2) *Cardiac*; (3) *Emboli*.

1. **SEPTICÆMIA.**—

a. **PYREXIA.**—High, 103° to 105°. Types: (i) Marked irregularity; (ii) Remittent or intermittent—e.g., daily 98° to 104°. (iii) Continuously high (rapid course).

b. **PROFUSE SWEATS.**

c. **PROGRESSIVE WEAKNESS**: finally delirium.

d. **ENLARGED SPLEEN** and, less commonly, liver.

e. **RASHES.**—Common. *Purpura*, petechiæ or large hæmorrhages.

VARIOUS.—Albuminuria frequent. Occasional slight jaundice. Diarrhœa, nephritis (occur apart from emboli).

2. **CARDIAC.**—*Murmurs* and physical signs very variable. May be: (a) *Rapidity* or irregularity of pulse; cardiac dilatation, usually but not always with murmurs (especially mitral); signs of cardiac failure. (b) No abnormal symptoms or signs.

3. **EMBOLI.**—May be multiple. Often diagnostic. Results are (a) mechanical, (b) suppurative.

Common Sites.—

Spleen: Pain in side.

Kidneys: Pain and hæmaturia; may be palpable.

Brain: Paralysis, aphasia, etc. (*See CEREBRAL EMBOLISM*, ABSCESS OF THE BRAIN.)

Retina: Retinal hæmorrhages; sight impaired; optic neuritis.

Intestines: Diarrhœa; intestinal obstruction.

Lungs, rarely (in right heart affections).

Note.—It is frequently difficult to be certain whether symptoms are septicæmic or embolic in origin—e.g., enlarged spleen, hæmaturia, purpura.

SKIN MANIFESTATIONS (important).—(1) Purpuric spots—may be only few, or numerous; (2) Osler's nodes—transient, red, tender erythematous spots, especially near tips of fingers and toes.

BLOOD.—Polynuclear leucocytosis.

URINE.—Blood-cells present.

Diagnosis.—Often difficult. Presence of organisms in the blood is the only absolute proof. Most important signs are: (1) Emboli; (2) Petechiæ (often earliest diagnostic sign); (3) Cardiac signs; (4) Blood culture; (5) Leucocytosis—frequent but not invariable; (6) Septic focus or chronic valvular disease; (7) Urine.

SPECIAL DIFFICULTIES.—

1. **SEPTICÆMIA**.—Often identical.

2. **ENTERIC**.—Agglutination reaction.

3. **SIMPLE ENDOCARDITIS**.—Severity and progress of symptoms.

4. **MALARIA**.—Blood examination.

Also from: miliary tuberculosis; abortus fever; meningitis; typhus.

Prognosis.—Invariably fatal.

Treatment.—Palliative.

SUBACUTE BACTERIAL ENDOCARDITIS.

(*Endocarditis Lenta*.)

Bacterial endocarditis due to infection with relatively non-virulent organism. Course is prolonged, often with intermissions, but is progressive and finally fatal.

Etiology.—Usually young adults. May or may not be previous evidences of rheumatism or endocarditis. Mental strain often appears to be a factor.

Bacteriology.—*Streptococcus viridans* most common: non-hæmolytic, of salivary or fæcal type. May be difficult to isolate.

Morbid Anatomy.—Vegetative endocarditis, often extensive and mural. Little ulceration.

Symptoms.—Onset insidious. Increasing weakness, dyspnœa, loss of weight, anæmia, and pallor. Sweats, shivering, and slight rigors. Slowly progressive in course of months.

TEMPERATURE.—No characteristic type. Variable evening rise: may be apyrexial periods.

FACIES.—Anæmic and sallow: 'café-au-lait' skin.

CARDIAC MANIFESTATIONS.—Pulse rapid. May be no abnormal signs and when present are rarely marked.

CLUBBING OF FINGERS.—May occur.

EMBOLIC MANIFESTATIONS.—(1) Purpura; (2) Osler's nodes (*see above*); (3) Transient painful swellings in joints and 'erythematous' areas in skin; (4) Urine—blood-cells usually present. Emboli in kidneys and other sites.

BLOOD.—May be polynuclear leucocytosis: not constant.

Duration.—May be one or two years or more. Always fatal.

CHAPTER CXLVII.

CHRONIC VALVULAR DISEASE.

I. AORTIC INCOMPETENCE.

Results from disease of aortic valves. Commoner in males, especially strong middle-aged men.

Causes.—

1. CONGENITAL MALFORMATIONS.—Rare. Usually fusion of cusps. Subsequently, chronic endocarditis.

2. ENDOCARDITIS.—In children and young adults.

MORBID ANATOMY.—As in *rheumatic endocarditis*: vegetations, sclerosis, and occasionally calcification. Often some stenosis also, and mitral valve affection.

3. SYPHILITIC AORTITIS.—Commonest cause in middle age. Wassermann reaction positive.

MORBID ANATOMY.—May be: (a) Aortitis involving aortic ring; (b) Aneurysm.

4. ARTERIOSCLEROSIS.—Especially in later life.

MORBID ANATOMY.—Valve surface puckered and shrunken, no vegetations. Stenosis unusual. Ancillary changes:—(a) Arteriosclerosis of aortic arch, whence interference with coronary arteries; (b) Atheroma.

5. RUPTURE OF A VALVE.—With healthy valves, very rare. From sudden strain, not necessarily severe, on valve previously diseased, especially in infective endocarditis.

Relative Incompetence.—Never from dilatation of left ventricle. Possibly from dilatation of aortic ring in: (a) Arteriosclerosis of aorta with dilatation above valves (valves usually arteriosclerotic also); (b) Aneurysm above valves.

Note.—*Stenosis* uncommon except in endocarditic group.

Effect of Aortic Incompetence.—Blood regurgitates from aorta to left ventricle, whence: (1) Deficient blood in systemic vessels (i.e., anæmia); (2) Overfilling of left ventricle.

COMPENSATION.—Overfilling of left ventricle causes dilatation followed by hypertrophy. Hypertrophy, by increasing output, corrects anæmia; dilatation corrects overfilling. Hence, *compensation established* and symptoms slight, though reserve power is diminished.

OTHER CHANGES IN HEART.—

Dilatation and hypertrophy of left auricle: associated with relative incompetence or disease of mitral valves.

Dilatation and hypertrophy of right heart: in chronic cases. In arteriosclerotic group: stenosis of coronary arteries, whence fibroid myocarditis. (Coronary circulation probably affected also in all forms by fall of diastolic pressure.)

In endocarditic group : may be 'dynamic dilatation of arch'; no post-mortem changes.

Systemic arteries : often sclerosed by high systolic pressure.

Size of heart.—Often 20 to 40 oz. (cor bovinum).

CARDIAC FAILURE.—May result from : (1) Failure of compensatory mechanism ; or (2) Onset of abnormal cardiac rhythms. Also from : (3) Sudden occurrence of incompetence—e.g., ruptured valve.

Symptoms.—May be latent.

1. **EARLY SYMPTOMS.**—Headache (often throbbing) ; giddiness ; faintness on rising or stooping ; flashes of light ; often irritability of temper, and defective memory (due to cerebral anæmia). Shortness of breath. Palpitation on exertion. Pain : often severe ; character varies—(a) dull precordial ache, (b) sharp pain radiating along arms, usually left, (c) attacks of angina ; (b) and (c) depend on changes in aorta and coronary arteries (*see ANEURYSM*). Anæmia : often marked.

2. **FAILING COMPENSATION.**—Shortness of breath, and discomfort. Cardiac pain. Œdema of feet. Nocturnal attacks of dyspnœa, and orthopnœa. Cough : œdematous or congested lungs. Bad dreams, disturbed and restless sleep, very common. Mental symptoms common towards end.

Uncommon.—*General œdema* (unless auricular fibrillation).

Hæmoptysis. Cyanosis. Emboli rare.

3. **SUDDEN DEATH.**—Frequent.

Physical Signs (in definite stage with hypertrophy).—

AORTIC FACIES.—Face long, drawn, tired, and anæmic ; distinctive from broad appearance in mitral disease.

INSPECTION.—Precordial pulsation extensive and forcible : often also in 2nd right space. Apex beat in 6th or 7th space, often outwards to axilla. (Pulsation often traceable from apex to large peripheral arteries. Between apex beat and sternum several spaces may retract during systole of ventricle.)

PALPATION.—Apex beat forcible and heaving, except with dilatation, when weak and wavy. *Rarely* : a diastolic thrill.

PERCUSSION.—Increase of cardiac dullness marked, especially downwards to the left.

AUSCULTATION.—Characteristic : *Diastolic murmur at base, conducted down sternum.*

SITE OF MURMUR.—Often audible *earliest* and best to *left* of sternum, near 4th cartilage, or at mid-sternum.

DIRECTION OF PROPAGATION.—Down sternum, rather than towards apex.

CHARACTER.—*Soft*, blowing, and prolonged.

AORTIC FIRST SOUND.—(1) Clear ; or more commonly : (2) Short systolic murmur—similar to that of aortic stenosis, but not proof of presence (double aortic, 'to-and-fro' murmur). In arteriosclerosis, murmur soft ; no thrill. In endocarditis, often rough, from vegetations ; sometimes a thrill ; may also be true stenosis.

Aortic Incompetence—Physical Signs, *continued*.

AORTIC SECOND SOUND.—(1) Replaced by murmur; or (2) Present with murmur.

AT MITRAL AREA.—Sounds dependent on condition of valves; affections common.

First Sound.—(1) Clear, in compensation; (2) Systolic murmur, often loud, from relative mitral incompetence, in dilatation, or from concomitant valve disease.

Second Sound.—Diastolic murmur from base may be audible.

Austin Flint Murmur.—Presystolic or late diastolic. Rumbling; limited to apex; variable and transient; there may be slight thrill. Occurs in about half of the cases. Ascribed to aortic regurgitant blood pushing anterior mitral valve in path of auricular blood entering ventricle. No systolic shock or loud first sound.

ARTERIES.—(1) Arteriosclerosis and tortuosity common. (2) Throbbing visible pulsation usually marked, e.g., in carotid, brachial, radial, retinal arteries, abdominal aorta; may be extreme. On auscultating large arteries—e.g., femoral—a to-and-fro murmur or systolic shock is audible.

CAPILLARY PULSATION.—Especially seen in finger-nails, lips, or line drawn across forehead. Occasionally in peripheral veins. Due to relaxation of peripheral vessels.

PULSE.—Characteristic, 'collapsing', Corrigan's 'water-hammer' pulse: short forcible impulse with rapid fall, due to high pulse-pressure. Best felt by grasping wrist and holding arm above head.

Sphygmograph: High quick ascent, sharp top, rapid fall, small diastolic wave. Characters of pulse due to compensatory dilatation of peripheral vessels, and not to regurgitation of blood.

BLOOD-PRESSURE.—Systolic pressure high, 160 to 180 mm. in arm; diastolic pressure low—viz., high *pulse-pressure*. Systolic pressure in lower extremities may be 50 to 80 mm. higher than in upper.

Radiographs.—Heart 'boot-shaped' from hypertrophy of left ventricle.

Rupture of a Valve.—*Valve previously diseased*; infective endocarditis common; also aneurysm of valve. Rupture invariably is due to a strain, not necessarily severe.

SYMPTOMS.—*Sudden cardiac pain*, immediately followed by extreme dyspnoea, great general distress, and cyanosis or earthy pallor. Patient may feel 'something give way in heart'. Symptoms *most urgent at onset*, and subsequently tend to improve with rest.

PHYSICAL SIGNS.—Sudden development of aortic diastolic murmur. Rapid dilatation of heart. Pulse rapid (partly psychical)

Prognosis.—Most serious of single valve lesions. Death always premature: gradual or often *sudden*. After recognition, life rarely exceeds 10 years, but may be full activity. (See PROGNOSIS IN VALVULAR LESIONS, p. 815.)

CARDIAC FAILURE.—Onset accelerated by: (1) Fibroid myocarditis, associated with sclerosis of coronary and other arteries. (2) Auricular fibrillation: is often obstinate. (3) Lesions of mitral valves.

ANGINA, and also PAROXYSMAL DYSPNŒA, often lead to rapid death.

II. AORTIC STENOSIS.

Etiology.—Less definite than other valvular lesions, as are the symptoms. Associated mainly with advanced arterial changes in old men. More rarely at younger ages, occasionally with rheumatic factors. Syphilis is a doubtful factor. Very rarely congenital. *Rare lesion*. Usually incompetence also present.

Morbid Anatomy.—Changes may be:—

1. Valves thick and rigid; may be calcified and orifice minute. Common form, especially in old men.
2. Valves adherent at margin, with little or no thickening. Mainly in younger cases.
3. Relative stenosis. Aorta greatly dilated, valves and ring normal.

Left ventricle hypertrophied; dilatation slight.

Effects of Aortic Stenosis.—*Hypertrophy of left ventricle* results from greater resistance to outflow, often with little or no dilatation. During compensation, other cardiac changes slight. With cardiac failure, dilatation of left and right cavities and pulmonary congestion.

Arteries: sclerosis less marked than with incompetence.

Pulse-pressure low.—Diastolic relatively high, about 140 and 100. Outflow of blood in general less than normal, although systole is increased in length.

Symptoms.—*Latent*, if compensated: often for years. Symptoms indefinite, and mainly referable to other lesions—i.e., aortic incompetence, mitral lesions, arterial changes (in old age).

1. EARLY SYMPTOMS.—Faintness. Giddiness. Symptoms marked in incompetence are less definite here—viz., headache, dyspnœa, palpitations, precordial pains, and angina.
2. WITH DILATATION AND CARDIAC FAILURE.—Dyspnœa, cough, general œdema.

Physical Signs.—

INSPECTION.—Precordial pulsation not extensive. *Apex beat* displaced downwards and slightly outwards, heaving.

PALPATION.—*Thrill*: maximum at aortic area, often intense.

PERCUSSION.—Area of cardiac dullness not greatly increased.

Aortic Stenosis—Physical Signs, *continued*.

AUSCULTATION.—

AORTIC AREA.—

1. Loud rough systolic murmur, often musical; maximum at aortic cartilage; conducted upwards into carotids.
2. Second sound: (a) Absent—commonly (valve sclerotic); (b) If present, short sound, from low blood-pressure; (c) Diastolic murmur frequent, from incompetence ('double aortic murmur').

MITRAL AREA.—Aortic murmur may be audible, or murmur of mitral incompetence.

PULSE.—Regular, slow, small long-drawn wave, tension hard.

Sphygmograph: Slow rise, sustained summit, slow fall. Often anacrotic. Occasionally bisferiens (double wave at summit): cause unknown.

NOTES ON PHYSICAL SIGNS.—

AORTIC SYSTOLIC MURMURS are common, and usually due to causes *other than* aortic stenosis, viz.—

1. Rough or calcified valves or vegetations, without narrowing.
2. Rough or atheromatous aorta.
3. Aneurysm or dilatation of aorta. Murmur may be marked, also thrill; but usually loud second sound is present, and other signs.
4. Hæmic murmurs in anæmia. Murmur faint, no thrill, no hypertrophy.
5. Aortic incompetence. Murmur not loud, no thrill.

In stenosis, the murmur is usually *louder*, rougher, and more musical than in other conditions.

Aortic murmurs of any origin are often audible posteriorly.

AORTIC THRILL.—Also felt in aneurysm, and occasionally slightly in roughened valves and aorta.

The heaving forcible apex beat associated with the small pulse contrasts with condition in incompetence.

Diagnosis.—Characteristic, especially in old men, are: (1) Aortic thrill. (2) Rough aortic systolic murmur, conducted into carotids. (3) Hypertrophy of left ventricle, with little dilatation. (4) Pulse: slow, small, hard, long wave.

No characteristic symptoms.

Aortic systolic murmurs are common *without* narrowing, and diagnosis of stenosis is justified only in presence of a thrill.

Prognosis depends considerably on condition of arteries and other valve lesions. Is regarded as least serious valvular lesion, but statistics show that life rarely exceeds a few years after diagnosis.

III. MITRAL INCOMPETENCE.

A condition in which the normal closure of the left auriculo-ventricular valves does not occur, thus permitting a reflux of blood from ventricle to auricle.

Etiology.—Two forms: (1) Valvular incompetence; (2) Muscular incompetence.

1. VALVULAR INCOMPETENCE.— Due to 'organic' changes in valves and valve ring.

CAUSE.—Endocarditis, of rheumatic origin : exceptions rare.

MORPH ANATOMY.—Thickening, deformity, contraction, and union of valves ; often changes in and shortening of chordæ tendineæ and papillary muscles. Valve ring generally thickened and contracted ; may be calcified. Near ring, endocardium often thickened, and myocardial changes (with Aschoff's nodes) (See ENDOCARDITIS)

Note.—Mitral stenosis in some degree is rarely absent.

2. MUSCULAR INCOMPETENCE. — Normal valves, functioning imperfectly. Occurs in —

a. DILATATION OF LEFT VENTRICLE — As in : (i) Aortic disease ; (ii) Chronic nephritis ; (iii) Arteriosclerosis ; (iv) Adherent pericardium. (v) Fatty heart.

b. WEAKNESS OF CARDIAC MUSCLE — In : (i) Anæmia ; (ii) Fevers

Effects of Mitral Incompetence (see also CARDIAC INSUFFICIENCY, p. 818).—

1. CHANGES IN THE HEART —

a. During ventricular systole, blood regurgitates. Auricle dilates from increased contents, and hypertrophies from increased work in expulsion

b. Left ventricle thus receives increased flow from auricle. Hence left ventricle similarly dilates and hypertrophies.

c. Emptying of pulmonary veins is impeded by ventricular flow. Hence right ventricle dilates and hypertrophies.

Later : Right auricle dilates and hypertrophies. Pulmonary arteries and veins dilate : often become atheromatous.

2. COMPENSATION.—Dilatation and hypertrophy as above, proceeding simultaneously and parallel with progress of lesion, result in normal peripheral circulation, often maintained for years : thus the lesion is 'compensated', mainly by hypertrophy of the two ventricles.

In muscular incompetence, compensation is less complete, owing to weakness of muscle.

3. CARDIAC FAILURE : DISTURBANCE OF COMPENSATION.—The balance so established may be disturbed by various factors :—

TYPE a.—(i) Recurrent endocarditis : increased incompetence. (ii) Affections of the lungs. (iii) Intercurrent diseases and fevers

TYPE b.—Abnormal cardiac rhythm, especially auricular fibrillation.

Symptoms.—No symptoms may occur during development of lesion and subsequently, if compensation efficient, except *shortness of breath on exertion*.

1. MINOR SYMPTOMS WHILE COMPENSATION EFFICIENT.—*Shortness of breath on exertion* : invariable. Commonly : Palpitation ; attacks of bronchitis (from pulmonary congestion). *Facies* : Broad and ruddy, venules on cheek dilated, cyanotic tinge of lips and ears ; often suggestive.

Mitral Incompetence—Symptoms, *continued*.

2. COMPENSATION FAILING.—

CHARACTERISTIC EARLY SYMPTOMS.—(a) *Palpitation*; feeble pulse; dilatation of heart. (b) *Dyspnoea*: on slight effort, later in severe paroxysms. (c) *Cough*: much sputum, *hæmoptysis* not common; signs of œdema or consolidation at bases. (d) *Edema of feet* (failing left ventricle). Auricular fibrillation may develop.

LATER.—General venous engorgement; often icteric tint. 'Sleep-starts' and restlessness. *Edema* spreads upwards to body (general anasarca), and to serous cavities, especially right hydrothorax. *Urine* scanty, concentrated; albumin present. *Liver* becomes large and tender (failing right ventricle). Emboli rare.

RECOVERY may occur with rest and treatment.

3. FINAL STAGE.—

Great suffering. Lividity. Orthopnoea. Constant restlessness and insomnia. May be vomiting. General œdema. Abdominal discomfort from ascites and tender liver. Position of maximum ease: sitting in chair, with trunk bent forward and arms lying on a rest.

DEATH.—Usually after recurrent attacks of failure. Sudden death rare.

Physical Signs.—

INSPECTION.—*Apex beat* displaced outwards, often in 6th space.

PALPATION.—*Apex beat* forcible. With failure, feeble and wavy.

PERCUSSION.—*Area of cardiac dullness* increased to left, and, with failure, to right also.

AUSCULTATION.—Characteristic are:—

MITRAL AREA.—Systolic murmur: maximum at apex: conducted into axilla; soft and blowing or loud and musical; loudest at onset and fades off gradually; replaces first sound partly or completely. *Note*: (1) Presystolic murmur common (stenosis). (2) When failure occurs, soft systolic murmur is heard at tricuspid area: if severe, often loud systolic only at all areas.

PULMONARY AREA.—Second sound accentuated.

PULSE.—In compensation, full and regular: practically normal.

Radiographs.—Prominence on left upper border due to left auricle and above it the pulmonary artery, obscuring the aortic knuckle.

Estimation of Degree of Regurgitation.—Loud systolic murmur is little guide: occurs with: (1) Small leak (especially 'high-pitched' murmur); (2) Good muscular compensation; (3) Large regurgitation. Accentuated pulmonary second sound: evidence of good compensation and against great regurgitation.

Severe incompetence suggested by: (1) Forcible apex beat with small pulse (much reflux blood); (2) Great width of cardiac dullness.

Diagnosis.—Usually simple. Characteristic: (1) Apical systolic murmur, conducted outwards; (2) Accentuated pulmonary second sound; (3) Lateral increase of cardiac dullness; (4) Frequently, rheumatic history. Presystolic murmur proves organic valvular disease.

Diagnosis (*see* CARDIAC SOUNDS AND MURMURS) from: (1) Functional murmurs (2) Relative valvular incompetence: in conditions of cardiac enlargements.

Mitral Incompetence in Children under 12 Years.—In acute rheumatic fever, over half develop valvular disease, mainly incompetence. Of cases of incompetence, about a third give no rheumatic history, but are otherwise indistinguishable: probably "endocarditis may be sole rheumatic manifestation" (Garrod).

NOTES ON MORBID ANATOMY.—Pure incompetence without stenosis not uncommon (in adults very rare). *Pericarditis* frequently coexists in rheumatic cases (in adults rare): prognosis bad.

NOTES ON SYMPTOMS - Recovery from attacks of failure usually good. *Deficient growth and nutrition* common with incomplete compensation: often deformity of thorax. Slow and delayed development during *puberty* improves prognosis.

IV. MITRAL STENOSIS.

Obstruction to the blood-stream resulting from changes in the left auriculo-ventricular valves and ring.

Etiology.—Due to rheumatic endocarditis in at least 90 per cent. Rarely scarlet fever. Arteriosclerosis is possible rare factor. Congenital: no evidence.

RELATION TO ACUTE RHEUMATIC ATTACK.—Physical signs of stenosis never develop during attack: stenosis is the result of slow sclerosis: minimum several months.

SEX.—Commoner in females, about 2 to 1 male. Ascribed to greater frequency of rheumatism and chorea.

AGE.—Symptoms become manifest at all ages, most commonly in young adult females, 20 to 30 years.

Morbid Anatomy (*see also* ENDOCARDITIS).—

CHANGES IN THE VALVES.—Adhesions, thickening, contraction, and calcification of mitral valves result in two types:—

1. **BUTTON-HOLE CONTRACTION.**—Usual form in adults. General changes of segments and ring result in flat firm mass with a slit as aperture.

2. **FUNNEL-SHAPED STENOSIS.**—Usual form in childhood. Cone formed by adhesion of valve edges, with little thickening. Aperture may admit tip of little finger: in advanced cases only a pencil or probe.

OTHER CARDIAC CHANGES.—

1. Hypertrophy of left auricle (firm muscular walls) and right ventricle. Left ventricle small. Total increase of heart, medium: weight 12 to 16 oz.

2. Ante-mortem thrombi in left auricle, especially appendix (whence emboli).

Mitral Stenosis, *continued*.

Effects of Mitral Stenosis.—Closely similar to mitral incompetence (q.v.), except: (1) Sequence of affected chambers; (2) Disturbances of rhythm frequent.

1. **SEQUENCE OF CHAMBERS AFFECTED.**—(a) Left auricle-hypertrophies in driving blood through stenosed orifice; (b) Right ventricle hypertrophies and dilates. Left ventricle remains small, receiving little blood.

2. **DISTURBANCES OF RHYTHM.**—Myocardium is often affected by rheumatic process, whence frequency of *auricular fibrillation*, heart-block, and paroxysmal tachycardia.

WITH AURICULAR FIBRILLATION.—Presystolic thrill and murmur disappear; mid-diastolic murmur present.

Physical signs of stenosis return with improved condition, viz., if fibrillation ceases.

FAILURE OF COMPENSATION occurs from: (1) Auricular fibrillation (usually); (2) Muscular failure.

Symptoms.—Often none for years except *slight shortness of breath*. Symptoms depend on the complications.

FAILURE OF COMPENSATION.—

DYSPŒA; COUGH; PALPITATIONS AND RAPID AND IRREGULAR HEART.—

Generally resembles mitral incompetence, but note that lungs and abdomen are specially affected (right ventricle failing); thus:—

Hæmoptysis is commoner and more profuse.

Œdema is rarely extreme, but ascites is more frequent.

Enlarged tender liver with ventricular pulsation is more frequent.

Physical Signs.—

INSPECTION.—*Pulsation*: left spaces near sternum. *Apex beat*: not displaced outwards.

PALPATION.—*Presystolic thrill*: almost pathognomonic, in 4th and 5th left spaces; rough and localized. *Systolic shock*: at termination of thrill, and synchronous with apex beat. *Apex beat*: palpable in 3rd and 4th spaces, often forcible, but varies.

PERCUSSION.—*Area of cardiac dullness* increased mainly to right of sternum.

AUSCULTATION (see also CARDIAC SOUNDS AND MURMURS).—

MITRAL AREA.—(1) *Presystolic murmur*, to right of apex; localized; rough; *crescendo*, ending sharply in loud first sound. (2) *First sound* very clear and loud. (3) *Second sound* reduplicated commonly. (4) *Mid-diastolic murmur* when stenosis fully developed. (5) *Frequently systolic murmur* due to incompetence.

PULMONARY AREA.—*Second sound* accentuated and often reduplicated.

AORTIC AREA.—Usually unaltered.

TRICUSPID AREA.—May be systolic murmur from incompetence.

COMBINED AUSCULTATION AND PALPATION.—(1) Pre-systolic thrill and murmur are synchronous. (2) Systolic shock, loud first sound, and apex beat are synchronous (systole well timed by finger on carotid artery).

PULSE.—Small. Completely irregular when auricular fibrillation supervenes.

VENOUS PULSATION.—With failing compensation and auricular fibrillation, systolic regurgitation of blood occurs into : (1) Cervical veins : pulsation and enlargement. (2) Liver : enlarges and rarely pulsates (in systole).

Radiographs.—

ANTERO-POSTERIOR POSITION—Prominence on left upper border from right ventricle or left auricle and above it the pulmonary artery, obscuring aortic knuckle. Right border formed by left and right auricle and in failure by right auricle alone.

RIGHT ANTERIOR OBLIQUE POSITION Dilated left auricle projects into retrocardiac space. Barium shadow shows oesophagus compressed by and curving round left auricle.

Complications.—

1. BRONCHITIS and pulmonary conditions -- Always serious.
 2. RECURRENT ATTACKS OF ENDOCARDITIS.
 3. EMBOLISM.—Special danger in mitral stenosis, from : (a) Thrombi in auricles ; (b) Fragments detached from the valves, less frequently. Usual sites : (i) *Cerebral vessels*, usually motor area, whence paralyzes and aphasia (left middle cerebral artery). (ii) Spleen : pain in left side. (iii) Kidney : lumbar pain, followed by hæmaturia. (iv) Pulmonary embolism and infarcts—clots from right auricle.
 4. DISTURBANCES OF RHYTHM.—Especially *auricular fibrillation* : occurs in majority of cases.
 5. HÆMOPTYSIS AND HÆMATEMESIS.—May give relief.
- Rarely :—
6. PARALYSIS OF LEFT VOCAL CORD.—Left recurrent laryngeal nerve inflamed by pressure between aortic arch and left pulmonary artery.

Diagnosis.—Simple when condition is fully developed.

CHARACTERISTIC PHYSICAL SIGNS.—(1) Presystolic thrill, ending in systolic shock ; (2) Presystolic murmur, ending in loud sharp first sound ; (3) Pulmonary second sound accentuated and often reduplicated.

IN LATER STAGES (auricular fibrillation), may be undiagnosable. PRESYSTOLIC MURMURS ALSO OCCUR IN :—

1. AORTIC INCOMPETENCE.—Austin Flint murmur. Soft murmur ; thrill slight or absent. No loud first sound.
2. ADHERENT PERICARDIUM.—Mitral stenosis not infrequently coexists, but presystolic murmur may occur in its absence. Difficultly rare, and of little practical importance.

HÆMOPTYSIS and COUGH occasionally suggest tuberculosis. Association of tuberculosis and mitral stenosis is very rare.

V. DISEASE OF THE TRICUSPID VALVE.

Rare. Usually acquired. Congenital very rare. Almost invariably other valves affected, and is evidence of serious cardiac failure.

Tricuspid Incompetence.—Tricuspid valves become incompetent with very slight increase of pressure. Two groups:—

1. ORGANIC, FROM ENDOCARDITIS.—Very rare.
2. RELATIVE INCOMPETENCE.—Common. Occurs with dilatation of right ventricle as sequel of: (a) Lesions of mitral and aortic valves; (b) Chronic obstruction of pulmonary circulation, e.g., bronchitis and emphysema.

PHYSICAL SIGNS.—Characteristic are:—

1. SYSTOLIC PULSATION IN CERVICAL VEINS.—Jugular greatly dilated and pulsating. From regurgitation.
2. HEPATIC ENLARGEMENT, WITH SYSTOLIC EXPANSILE PULSATION.
3. SYSTOLIC MURMUR OVER LOWER STERNUM.—Soft; localized, or less often conducted to the right. Usually distinguishable from coexistent mitral murmur.

Other signs are:—

4. Pulsation to right of sternum and in epigastrium.
5. Area of cardiac dullness increased to right.

Venous pulse tracings show that regurgitation may occur without a systolic murmur.

SYMPTOMS.—Due to venous and pulmonary congestion, and to the coexistent valvular lesions. Cyanosis and venous engorgement in neck. Dyspnoea and orthopnoea marked.

Tricuspid Stenosis.—Rare. Diagnosis unusual. Of rheumatic origin. Mitral stenosis almost invariably present. Occasionally aortic disease. *Congenital*: Rare, usually fatal at birth.

PHYSICAL SIGNS.—Usually indefinite. May be:—

1. Presystolic pulsation in cervical veins (venous tracing) and in liver. The most constant sign.
2. Presystolic thrill over sternum, and systolic shock. First sound accentuated.
3. Presystolic or diastolic murmur over sternum. *Rarely* present.
4. Cardiac dullness increased to right.

SYMPTOMS.—Cyanosis, dyspnoea, and oedema marked. Also enlarged liver. Symptoms of cardiac failure.

VI. DISEASE OF THE PULMONARY VALVES.

Pulmonary murmurs are common (*see* CARDIAC MURMURS). The causes are various, but *acquired* valvular disease is very rare. Is the commonest site of *congenital lesions*; the malformed valves may be attacked later by endocarditis—fœtal, acute, chronic, or infective.

Pulmonary Stenosis.—Common congenital lesion. Valves adherent. Often with patent ductus arteriosus and ventricular septum. (*See* CONGENITAL AFFECTIONS OF THE HEART, p. 826.)

PHYSICAL SIGNS.—Systolic thrill and murmur in 2nd left space: but signs often doubtful.

Pulmonary Incompetence.—Rarest valvular lesion.

ETIOLOGY.—(1) Infective endocarditis: commonest cause. (2) Aortic aneurysm compressing pulmonary artery. (3) Congenital lesions, usually with stenosis. (4) Relative incompetence: secondary to mitral stenosis, high pulmonary blood-pressure, and dilated pulmonary artery.

SYMPTOMS.—Those of infective endocarditis or cardiac lesions. Emboli in lungs and hæmoptysis frequent.

PHYSICAL SIGNS.—Diastolic murmur to left of sternum.

'GRAHAM STEELL'S MURMUR'.—Soft diastolic, maximum in second and third left spaces in advanced mitral stenosis, attributed to pulmonary incompetence. Distinguished from aortic diastolic by absence of aortic manifestations

DIAGNOSIS.—Difficult, owing to presence of other lesions.

VII. COMBINED VALVULAR LESIONS.

Lesions of two or more valves may consist of:—

1. **Two Organic Lesions.**—Especially rheumatic lesions of mitral and aortic valves in children.
2. **One Lesion Organic and One Relative.**—Very common, as in tricuspid incompetence with organic mitral stenosis, and mitral incompetence with organic aortic disease.

Two types of lesion may occur in the same valve—e.g., mitral incompetence and stenosis.

VIII. PROGNOSIS IN VALVULAR LESIONS.

General Considerations.—

1. Prognosis depends pre-eminently on *the condition of the myocardium*. Consider:—
 - a. Has the myocardium been affected by the morbid process causing the valve lesion?
 - b. The capacity of the myocardium to neutralize the effects of the lesion.
 - c. The capacity of the myocardium in relation to the necessities of the individual.
 - d. The etiology: (i) Arteriosclerosis and syphilis: coronary arteries invariably affected; hence progressive myocarditis. (ii) Rheumatism: coronary arteries escape.
2. Is the lesion progressive or stationary? (a) If progressive, does rest control it?—if it does not, prognosis obviously bad. (b) If stationary, prognosis depends entirely on myocardium: a lesion unvaried for three years only progresses under fresh stimulus.
3. In the *absence* of cardiac failure, investigate specially the effects of measured *exercise*—viz., the reserve power of the heart and its response to exertion.
4. In the *presence* of symptoms of cardiac failure, investigate specially the effects of *rest*—viz., the power of the heart to recover and then to carry on the minimum necessary work.

Prognosis in Valvular Lesions—General Considerations, *continued*.

5. Consider the etiology, symptoms and signs, electrocardiograph and radiograph, from the standpoint of the myocardium. Thus, a normal regular pulse and apex beat undisturbed prove that there is little myocardial disturbance.

EFFECTS OF MEASURED EXERCISE IN ABSENCE OF CARDIAC FAILURE.—If symptoms appear after exertion, consider :—

1. The minimum amount of exertion producing dyspnoea or pain. How far can patient walk without distress ?
2. After 'Exercise Tolerance Test' :—
 - a. Is the pulse-rate excessive ? Is there cyanosis ?
 - b. Does the rate return approximately to normal in three minutes ?
3. What routine and occupation in life can the heart support on this evidence ?

EFFECTS OF REST IN PRESENCE OF SYMPTOMS OF CARDIAC FAILURE.—*Defer prognosis* until effects of rest are available, noting :—

1. Extent of recovery. Can myocardium support minimum exertion necessary for circulation, and provide any reserve for work.
2. Is lesion progressive or stationary ? If no recovery occurs, expectation is a few months of life.

A first attack of failure is rarely fatal.

Special Considerations.—(1) *Age* ; (2) *Sex* ; (3) *Etiology* ; (4) *Value affected* ; (5) *Pregnancy*.

1. **AGE.**—Prognosis bad in children under 12 years. Factors : (a) Pericarditis common ; (b) Affections of multiple valves ; (c) Lesions often progressive ; (d) Recurrent attacks of rheumatism—often overlooked owing to the slight articular manifestations ; (e) Strain of puberty. Sudden death rare (coronary arteries healthy).
2. **SEX.**—Better in females. Factors : (a) Mitral lesions commoner than aortic ; (b) Coronary arteries less often affected (syphilis and arteriosclerosis less common).
3. **ETIOLOGY.**—(a) Arteriosclerosis and syphilis : affect coronary arteries invariably. (b) Rheumatism : coronary arteries escape (but myocardium often and A-V bundle occasionally affected, resulting later in disturbances of rhythm) ; liability to recurrence based on previous attacks and family history.
4. **VALVE AFFECTED.**—

AORTIC INCOMPETENCE.—Prognosis depends upon :—

- a. *The Condition of the Aortic Valves.*—The extent of regurgitation is measured less by murmur than by vascular phenomena : (i) collapsing pulse, blood-pressure and pulse-pressure ; (ii) Symptoms, e.g., dizziness.
- b. *The Coronary Arteries* (the dominating factor).—Affection, and also that of myocardium, varies with

etiology: in order—syphilis, arteriosclerosis, and, much less, rheumatism.

- c. *Myocardium*.—Affection measured by: (i) Etiology. (ii) Symptoms: especially *cardiac pain* and *angina*; also dyspnoea. (iii) Physical signs: (a) Hypertrophy and dilatation; (b) Failure of contractility, shown by *pulsus alternans*. (iv) Effects of exercise.
- d. *Angina*.—Associated with sudden death. As also *paroxysmal dyspnoea*.
- e. *Lesions of Mitral Valves*.—Accelerate cardiac failure.
- f. *Auricular Fibrillation*.—Often obstinate. Accelerates cardiac failure.
- g. *Age*.—Duration longest when onset in youth: origin being endocarditic, coronary circulation is free, and muscle not fibrotic; most favourable if mitral valves unaffected.

Prognosis most serious of all valve lesions. May exist without symptoms for years, fully compensated, but death always premature, either gradually or *often suddenly*. After recognition, life rarely exceeds 10 years, and if syphilitic 5 years.

Sudden death common, especially in syphilis (40 per cent—Coombs), from: (i) Coronary thrombosis; (ii) Ventricular fibrillation (probably).

AORTIC STENOSIS.—Prognosis best of all valve lesions: often found in middle life, and compensated for years. Consider: (a) Condition of valve: obstruction measured by flattening of pulse curve. (b) Myocardium (as in aortic incompetence). Prognosis also depends on condition of arteries (important) and of other valves.

Note.—The traditional good prognosis is scarcely supported by published statistics: age at death in observed cases rarely much exceeds 40.

MITRAL INCOMPETENCE.—Prognosis best with some stenosis, but essentially depends on condition of myocardium: hence investigation of impairment is of special importance. May be compensated for years, with active life.

Of physical signs: (a) Loudness of murmur is little guide; (b) Accentuation of pulmonary second sound measures condition of circulation in lungs.

In aortic and myocardial disease, pain and symptoms often relieved at onset of mitral incompetence (apical systolic murmur), but prognosis not improved.

MITRAL STENOSIS.—Prognosis varies with:—

- a. *Disturbances of Rhythm* (auricular fibrillation, etc.).—Irregularity of pulse: Note: (i) Type of irregularity: permanent or transient. (ii) Effect of treatment: digitalis should cause marked improvement within a week.

- b. *Venous Stasis and 'Back-pressure' Phenomena*.—Note: cough, dyspnoea, crepitations, and later engorged cervical veins and enlarged liver.

Prognosis in Valvular Lesions—Mitral Stenosis, continued.

- c. Certain Special Conditions.*—(i) Embolism: cerebral, etc.
 (ii) Hæmoptysis: may be profuse, but never fatal.
 (iii) Pregnancy.

5. **PREGNANCY.**—Borne worst in mitral stenosis; inadvisable, but after onset of cardiac symptoms improvement but rarely follows premature delivery; death during parturition very rare. In mitral incompetence, repeated pregnancies not infrequent.

General Conclusion.—Best prognosis results from:—

1. **MYOCARDIUM.**—If response to exertion shows reserve power sufficient for individual's necessary occupation.
2. **VALVE LESION.**—Of rheumatic origin, if condition stationary during three years.

Anæsthetics and Valvular Lesions.—Administration safe if no symptoms or if there is rapid recovery after exertion. Dangerous with pulmonary disturbances, obesity, and pulsus alternans.

IX. CARDIAC INSUFFICIENCY AND FAILURE.

Cardiac failure is the inability of the heart to maintain an efficient circulation. A valvular lesion will cause increased work to a chamber: the wall will hypertrophy and, if this proceeds parallel with the advance of the lesion, will 'compensate' it. Cardiac failure may occur from two causes: (1) Failure of muscle, resulting from malnutrition, advance of lesion, etc. (2) Abnormal rhythms interfering with contractions (etiology as in DILATATION). The two main theories of mode of occurrence of cardiac failure described below are correlated to these two factors.

Cardiac failure may be: (1) *Acute*: either sudden death or rapid failure. (2) *Chronic*: slow onset and progress.

The power of the heart is divisible into: (1) Rest force: used in normal circulation. (2) Reserve force: used in exertion and emergencies. The latter is exhausted first, and hence capabilities of a heart can be estimated by testing amount of reserve, even previous to onset of symptoms of failure (see PROGNOSIS IN VALVULAR LESIONS, p. 815).

Mode of Occurrence of Cardiac Failure.—There are two main theories at present under discussion.

1. **THEORY OF 'BACK PRESSURE'**, exemplified by failing mitral incompetence, thus:—
 - a. Left ventricle fails to expel normal volume into aorta, as result of: (i) Progressing valvular disease and incompetence; or (ii) Exhaustion of ventricular muscle. In both conditions the left heart (*ventricle and auricle*) overfills, dilates, and fails to various degrees.
 - b. Pulmonary circulation becomes overfilled and the left congested owing to stagnation in left auricle.
 - c. Right ventricle dilates as result of (b), becomes overfilled, dilates, and fails, and consequently the right auricle accumulates blood.
 - d. Right auricle similarly fails, and the systemic veins become engorged.

Note.—A similar sequence is applied to mitral stenosis, the failure commencing with the *left auricle*, and passing through the right heart and systemic circulation before affecting the left ventricle.

2. **THEORY OF MUSCLE FAILURE.**—The cardiac muscle fails (i.e., the function of 'tonicity' is lost). Such failure is due principally to: (a) Myocarditis: the myocardium being affected even by rheumatism to a greater degree than has been realized. (b) Abnormal rhythms introducing new factors and strains, especially auricular fibrillation.

The failure of the right ventricle and heart in general is ascribed to: (a) Synchronous failure of both ventricles under abnormal rhythm; (b) The failure of the left ventricle affects the systemic circulation, resulting in œdema, venous stasis, etc., leading to malnutrition of the heart.

OBJECTIONS ADVANCED TO 'BACK-PRESSURE' THEORY AND SUPPORTING MUSCLE FAILURE INCLUDE.—

1. In slight cardiac failure, the right ventricle may be dilated in the absence of 'back pressure'.
2. All signs ascribed to 'back pressure' may occur in absence of any valvular lesion—e.g., in a paroxysm of tachycardia in an apparently healthy heart.
3. Cardiac failure may occur suddenly—e.g., with auricular fibrillation in mitral stenosis. No evidence of 'back pressure' or alteration in valve; 'compensation' previously complete, and no cause for its sudden failure.

COMPARISON OF THE THEORIES.—

The 'back-pressure' theory considers that the *chambers* fail consecutively; it is supported by occurrence of symptoms in sequence.

The muscle-failure theory considers that the cardiac *muscle* (or at least that of the ventricles) fails simultaneously, and that the failure of the left ventricle is the essential factor; it is supported by the occurrence of failure: (a) without 'back-pressure' factors; (b) without 'back-pressure' symptoms; (c) with the simultaneous occurrence of all 'back-pressure' symptoms.

The second theory is advanced especially by those who have most studied abnormal rhythms, and explains sudden cardiac failure in previously compensated hearts under influence of such rhythms: ventricular fibrillation being assumed in some cases, a condition obviously incompatible with life, however healthy the muscle might be. The 'back-pressure' theory especially applies to and explains certain valvular diseases and cases of slowly-occurring cardiac failure.

The two methods are not mutually exclusive; they probably occur not only separately but often together, especially in severe cardiac conditions in which muscle and valves are both definitely affected.

Cardiac Insufficiency and Failure, *continued*.

Etiology.—

1. ACUTE CARDIAC FAILURE.—(a) Coronary thrombosis.
(b) Acute infections—e.g., diphtheria. (c) Functional disturbances of rhythm—e.g., paroxysmal tachycardia, auricular flutter, heart-block. (d) Thrombosis or embolism of pulmonary artery. Note also acute pulmonary œdema, and cerebral embolism and hæmorrhage.

Failure (and death) may be rapid (or sudden).

Symptoms: cardiac pain and distress; may be paroxysmal dyspnœa; pulse rapid, slow, or irregular; unconsciousness.

2. CHRONIC CARDIAC FAILURE.—(a) Diseases of the myocardium (q.v.). (b) Lesions of the valves. (c) Functional disturbances of rhythm: lesions of myocardium or valves usually present. (d) Conditions increasing blood-pressure: (i) Pulmonary circulation: chronic bronchitis, emphysema, fibroid lung, etc. (ii) Systemic circulation: arteriosclerosis, chronic nephritis, etc. (e) Thyrotoxicosis. (f) Mechanical interference with cardiac contractions: adherent pericardium (myocarditis usually coexists); rarely pleuritic adhesions.

CONGESTIVE HEART FAILURE.

Symptoms at Onset.—

2. EARLY SYMPTOMS AT ONSET OF FAILURE.—

- a. Failure mainly of *right ventricle* as in mitral incompetence (p. 809).
- b. Failure mainly of *left ventricle* as in fibroid myocarditis (p. 795).

General Summary of Symptoms.—

- a. CARDIOVASCULAR SYSTEM.—Cardiac symptoms usually slight. Palpitation uncommon. *Pain*: mainly associated with arterial changes; precordial pain uncommon (for distribution, *see* ANEURYSM). Pallor. Cyanosis. Giddiness. Faintness. Flashes of light.
- b. RESPIRATORY SYSTEM.—(i) *Dyspnœa*: Shortness of breath early and invariable, especially on exertion; severity increases to orthopnœa. (ii) *Cough*: From pulmonary congestion. (iii) *Hæmoptysis*: (α) Mainly in mitral valve lesions—often causes relief; (β) From infarcts. Paroxysmal dyspnœa ('cardiac asthma') in fibroid and fatty myocarditis. May be 'Cheyne-Stokes' breathing.
- c. ŒDEMA.—Commences in feet; tends to spread upwards; especially in mitral incompetence. *Ascites*, especially in mitral stenosis.
- d. ALIMENTARY SYSTEM.—Loss of appetite; dyspepsia and nausea; flatulence; constipation. Vomiting: prognosis serious: partly a vagal reflex. Diarrhœa, from œdematous mucosa. Pain, caused by (i) gastric disturbance, (ii) tender liver.

- e. **NERVOUS SYSTEM.**—Sleeplessness and restlessness, 'night starts'; memory impaired; may be delusions. Gross lesions: embolism (especially in mitral stenosis); hæmorrhage.
- f. **RENAL SYSTEM.**—Diminished urine; high colour, specific gravity, and urea content; albuminuria and casts. Results from (i) œdema reducing quantity, (ii) injury by stasis. *Blood urea*: may rise to 100 mgm. per cent (fall on recovery). *Blood cholesterol*: 100 to 150 mgm. per cent.
- g. **BLOOD-PRESSURE.**—No constant changes.

Physical Signs (Cardiac).—

PULSE.—Commonly *weak, rapid, low tension*. Varies greatly with lesion and associated conditions. In auricular fibrillation (mitral stenosis), complete irregularity. With myocarditis and abnormal rhythms, may be slow, intermittent, or grouped beats; in aortic incompetence, high tension; but in all final stages it is usually weak and rapid. May be gallop rhythm.

INSPECTION.—Apex beat outside mid-clavicular line, diffuse and feeble. Pulsation over increased area.

PERCUSSION.—Cardiac dullness increased, to left or right.

AUSCULTATION.—Sounds feeble. Gallop rhythm common.

Various murmurs: may be universal systolic: or none.

PULSATION IN CERVICAL VEINS.—Marked if right ventricle fails.

Morbid Anatomy.—

HEART.—Changes depend on causal disease.

In other organs, changes are mainly result of *passive hyperæmia* from venous congestion.

LUNGS.—Principal changes (*see also* PASSIVE CONGESTION OF THE LUNGS, p. 578):—

1. **HYPOSTATIC PNEUMONIA OR ENGORGEMENT—SPLENIZATION OF LUNG.**—Posterior and basal portions of lung affected.

Macroscopic: Solid, dark-blue surface. On section, resembles spleen; on pressure, blood and fluid.

Histology: Capillaries distended. Fluid in alveoli.

2. **BROWN INDURATION.**—From long-continued passive hyperæmia: especially in mitral stenosis.

Macroscopic: Brownish colour. Bulky (not collapsing) and tough.

Histology: Dilated capillaries. Epithelial cells swollen, free in alveoli, contain pigment.

In later stages, connective tissue increased; extravasated blood; much dark pigment ('cyanotic induration').

3. **RED INFARCTS.**—Especially in mitral stenosis. *Site*: lower lobes.

LIVER.—'Nutmeg liver.' (*See* PASSIVE CONGESTION OF THE LIVER, p. 509.)

KIDNEYS.—Passive hyperæmia: large, firm, red kidneys. Capsule strips readily. Stellate vessels injected. On section, drips blood; glomeruli visible.

Later: Increased connective tissue; vessels dilated; atrophy of epithelium; blood in tubules ('cyanotic induration').

Congestive Heart Failure, *continued*.

Relation of Gastric and Cardiac Disturbances.—*Flatulence*, etc., frequently occur with and aggravate cardiac conditions. Relations obscure. Cause probably varies:—

1. Weakness of right ventricle: hence stasis in abdominal veins, impeded gastric circulation, secretions affected, and 'gastric insufficiency'. Particularly in valvular lesions.
2. Weakness of left ventricle: hence inefficient circulation, secretions affected, and 'gastric insufficiency'.

In myocardial lesions, 'heart attacks' are frequently associated with attacks of flatulence, and end abruptly on eructation or passage of flatus. Relation may be: (a) On cessation of an abnormal rhythm, evacuation of flatus follows; or (b) Evacuation of flatus relieves a mechanical pressure on heart, and cessation of abnormal rhythm results. Patients invariably adhere to latter explanation. Supported by onset of attacks after heavy meals or, occasionally, experimental distension of stomach. Influence of abdominal pressure exhibited in certain cases of 'simple paroxysmal tachycardia' being prevented or aborted by firm abdominal binder. Aerophagy is a possible factor.

X. TREATMENT OF MYOCARDIAL AND VALVULAR LESIONS.

General Principles of Treatment.—

1. SLIGHT LESIONS AND STAGE OF COMPENSATION.—

(a) Avoid strains—physical and mental; especially, in aortic disease, coition. (b) Maintain general health; special attention to digestive and excretory systems.

EXERCISE.—Regular. Beneficial while causing no distress.

SLEEP AND REST.—Ten hours in bed.

DIET.—Ordinary moderate diet. Preferably *dry diet*, with fluid between meals, especially in myocardial lesions. Limit quantity of fluid (50 oz.). Tobacco: moderate. Alcohol: very little.

BOWELS.—Saline purge (mag. sulph. ʒij to iv) twice weekly.

Calomel gr. ij fortnightly (especially in myocardial lesions).

DRUGS.—*Digitalis* is *contra-indicated*. Iron, arsenic, strychnine: occasionally, as general tonic.

Prophylaxis in Children.—Attend to tonsils, adenoids, teeth, and nose. Avoid chills.

2. STAGE OF CONGESTIVE HEART FAILURE.

a. **REST.**—The first essential. Absolute in bed. In slight failure (e.g., oedema of ankles), one to two weeks in bed often sufficient and only necessary treatment. Tendency to bedsores.

Posture: Decide by patient's feelings. Recumbency gives maximum rest to heart. *The greater the dyspnoea the higher should be the shoulders:* final stages may necessitate sitting in chair with head and arms on a rest. Crossbar on rope over bed often great assistance.

b. DIET.—In severe cases, fluids only; especially beef-juice, white of eggs; quantity limited; avoid starchy foods and milk slops. Give solid food as early as possible, fluids separately.

Reduction of fluids and 'dry diet' indicated in stout, flatulent, and myocardial cases.

c. DIGITALIS.—Indicated in general. The principles of digitalis therapy are considered at the end of this section. Quinidine not to be given in acute stages, or with long-standing auricular fibrillation.

d. VENESECTION.—*Indications*: In: (i) arteriosclerosis with high blood-pressure; (ii) Excessive dyspnoea and cyanosis; (iii) Acute pulmonary oedema. Remove *not less than* 20 oz.

e. BOWELS.—Freely opened: salines best (mag. sulph.).

Special Symptoms.—Digitalis, by improving circulation, is main treatment of most symptoms.

SLEEPLESSNESS AND RESTLESSNESS.—Often serious, and treatment essential.

MORPHIA.—If symptoms severe; especially in arteriosclerosis.

Morphia is the most valuable drug in failure, next to digitalis, and *should be given freely*. With bronchitis, add atropine gr. $\frac{1}{100}$ - $\frac{1}{50}$; sleep must not be over-long.

Milder degrees: Paraldehyde; chloral hydrate, gr. v-xv, t.d.s. If chronic, try hot whisky.

ŒDEMA.—(1) Rest. (2) Digitalis. (3) Salines. (4) Puncture legs if oedema persistent: Southey's tubes or multiple scarification: many pints drain daily (perform aseptically). Ascites or hydrothorax: remove if persistent. Hot packs unsatisfactory and weaken pulse.

SPECIAL DRUGS.—Especially with diminished urine, but often ineffectual. Diuretin gr. lx-xc daily; theocin sod. acetate gr. x-xv daily.

MERCURIAL DIURETICS—Most efficient drugs. *Salyrgan*: dose 1 c.c. as prepared diluted with 5 c.c. saline, injected intravenously; may be repeated every few days if effective; action increased by giving ammonium chloride gr. xx, t.d.s. in capsule. Intolerance shown by hæmaturia or diarrhoea. *Novurit*: also effective in suppository.

DYSPNOEA.—(1) Rest in bed and special postures. (2) Morphia, if restless. Examine for hydrothorax.

COUGH.—Special treatment of little avail: due to heart condition.

HÆMOPYSIS.—Usually beneficial. Sedatives if excessive.

PALPITATION AND CARDIAC DISTRESS.—Leeches. Flying blisters. Flatulence may be cause.

GASTRIC SYMPTOMS.—(1) Omit digitalis. (2) Dietetic treatment. (3) For flatulence: alkalis, peppermint, etc. (4) Vomiting—serious and troublesome symptom: ice to suck, champagne, soda-water.

Treatment of Myocardial and Valvular Lesions, *continued*.

Other Remedies.—

CARDIAC STIMULANTS.—No drug replaces digitalis: when it fails, others of group likewise do so.

STROPHANTHUS: *In acute failure*, intravenous injection strophanthin gr. $\frac{1}{100}$ in normal saline Mxx; repeat for three doses two-hourly; action rapid.

ETHER AND ALCOHOL: Spt. ætheris Mxxx-lx: spt. ammon. aromat. Mxxx-lx, in a little water; rapid action; useful in fainting and sudden cardiac distress.

CAFFEINE SODIUM SALICYLATE: Hypodermic injection gr. j-ij; action rapid.

CAFFEINE CITRATE: By mouth, gr. v-x t.d.s.; inferior to digitalis.

OTHER DRUGS: No evidence in favour of caffeine, cardiazol, quinine. Quinidine is *contra-indicated in cardiac failure*, and must never be given with digitalis. Nitrites are for anginal attacks.

OXYGEN.—Useful when cyanosis present, as with bronchitis and emphysema, or cardiac asthma. Administer 5 to 10 minutes every hour. Preferably oxygen tent.

IODIDES.—In arteriosclerosis and high blood-pressure.

Digitalis—General Principles of Therapy.—

INDICATIONS FOR ADMINISTRATION.—*The occurrence of symptoms from cardiac muscular failure:* lesion may be myocardial, valvular, or disturbance of rhythm, resulting in *dilatation of heart*.

CONTRA-INDICATIONS.—(1) Compensated lesions and cardiac disease in absence of symptoms; (2) Palpitations, tachycardia, arrhythmia are not indications in absence of symptoms; (3) Angina pectoris; (4) Aneurysms. With vomiting and nausea, useful doses are rarely practicable.

SPECIALLY BENEFICIAL.—(1) In mitral lesions (often stenosis) with irregular pulse and œdema, viz., *auricular fibrillation*; also *auricular flutter*. (2) All cardiac diseases with œdema.

ACUTE CARDIAC FAILURE.—Less effective.

AORTIC INCOMPETENCE.—Less effective than in mitral lesions; in rare cases rapid death if over-administered; but digitalis is *definitely indicated* with œdema or auricular fibrillation. The objection is often advanced that digitalis prolongs diastole, and hence increases effect of regurgitation; but probably occurrence of sudden death is associated rather with the advanced myocarditis which is frequently present.

Action of Digitalis.—

MAIN EFFECTS.—

1. **HEART.**—Rate slowed, increased force of contraction; diastole lengthened.
2. **PERIPHERAL ARTERIES.**—Tension raised (experimental); blood-pressure *not* increased clinically.

RESULTS AND MEASURE OF ACTION.—Circulation improved : hence practically treats all symptoms of failure. Specially shown by :—

1. URINE.—Increased, often very greatly. Should commence in forty-eight hours. Regular measurement important.
2. PULSE.—Slower, more regular. Expected in four to seven days. Occasionally irregularity remains even with marked general improvement.
3. OEDEMA.—Diminishes.

Ill-effects of Digitalis, indicating omission or reduction.—

1. TOXIC.—*Nausea, headache, vomiting, occasionally diarrhoea.*
2. PULSE.—‘*Coupled beats*’: indication for *immediate omission*. May be: (a) Pulsus bigeminus; alternate beat is an extrasystole; intervals alternately long and short. (b) Pulsus alternans; rhythm regular; alternate strong and weak beat; serious. In both forms weak beat may not reach wrist (radial rate half apex beat). Other changes: extrasystoles, heart-block (partial or rarely complete); especially in myocardial lesions.

Diminution of urine is a sign of inefficiency of digitalis.

Hence, always watch the pulse and measure the urine.

‘Cumulative action’ over-emphasized: with above precautions, risk of sudden ill-effects is negligible.

Method of Administration of Digitalis.—

1. Commence with large doses: Tincture ℥20, 30, or 40, three or four times daily.
2. If no reaction in four days, increase until (a) pulse slows, or (b) ill-effects appear.
3. After seven to ten days, or previously if pulse becomes regular and slow (80), omit. Recommence in three to four days with half doses.

MASSIVE DOSAGE.—With severe cardiac failure, an initial dose of 3j is good treatment, and this dose may be repeated under careful observation.

COMPENSATION RE-ESTABLISHED.—Frequently patients benefit subsequently from tincture ℥v, t.d.s., over prolonged periods.

GUY’S PILL (Powdered squill, powdered digitalis, calomel, āā gr. j).—Especially in arteriosclerosis and oedema.

IODIDES should be added in cases of arteriosclerosis and high blood-pressure (pot. iodid. gr. iij–v in each dose).

Digitalis Preparations.—The *tincture* (B.P.) is reliable. Nativelle’s granules of digitalin often convenient; ‘white granule’ gr. $\frac{1}{15}$ is equivalent of tincture ℥xxx.

DIGOXIN.—Rapid effect. Intravenous: 0.5 to 1 mgm. in 1 c.c. solution diluted to 10 c.c. with normal saline. By mouth: 0.25 mgm. t.d.s.

CHAPTER CXLVIII.

SPECIAL PATHOLOGICAL CONDITIONS
OF THE HEART.

Aneurysm of the Valves.—Usually aortic valves. From acute endocarditis, simple or infective, causing softening. No symptom from aneurysm, but rupture common—i e., rupture of valve.

Aneurysm of the Walls.—

ETIOLOGY.—Local softening of walls from : (1) Syphilis or thrombosis of coronary arteries. Less often : (2) Infective and pyæmic conditions of endocardium and myocardium ; (3) Gumina.

SITE.—Left ventricle near apex. Less often near interventricular septum. May attain size of heart.

SYMPTOMS AND SIGNS.—Indefinite : bulging or expansile pulsation of chest may occur.

TERMINATION.—(1) Cardiac failure, from sac interfering with movements of heart : usual. (2) Rupture into pericardium : less common. (3) Pericarditis : occasionally.

Rupture of the Heart.—Very rare.

ETIOLOGY.—(1) Fatty or fibrous myocarditis ; (2) Acute softening from coronary thrombosis, gumma, or local suppuration—less frequently. Usually in elderly men. *Rupture* occurs during exertion, with sudden death ; rarely acute pain and dyspnœa, and life for a few hours.

SITE.—Left ventricle, anterior wall.

New Growths and Parasites.—

SYPHILIS.—All others rare.

TUBERCLE and PRIMARY NEOPLASMS.—Very rare.

SECONDARY GROWTHS.—Heart usually unaffected even by tumours of lungs and mediastinum attacking the pericardium. Melanotic sarcoma may invade heart.

FLUID CYSTS, clear or sanious, are on record.

PARASITES.—Rare. Occasionally hydatid cysts, and very rarely cysticercus of *Tænia solium*.

CHAPTER CXLIX.

CONGENITAL AFFECTIONS OF THE HEART.

Many of these affections are incompatible with life. Subjects who survive infancy are mainly those with lesions of the pulmonary orifice. Malformations elsewhere in body often coexist. *Right side* of heart affected much more commonly than left. Males commoner than females. First-born often affected.

Etiology.—(1) *Fatal endocarditis* ; (2) *Maldevelopment*. The forms often coexist and are difficult to distinguish in valvular lesions.

Fœtal Endocarditis.—

SITE.—Pulmonary valves most commonly.

MORBID ANATOMY.—*Sclerosis.* Valves thicken at edges, unite, and contract; very smooth; vegetations very rare. (1) Pulmonary valves (less often aortic): valves often completely united, forming ring with narrow orifice. (2) Mitral and tricuspid valves: edges fuse: chordæ tendinæ thick and shortened: rare.

PREVALENCE ON RIGHT SIDE ASCRIBED TO: (1) Higher blood-pressure; (2) Malformations commoner, with subsequent endocarditis; (3) Toxins from placenta.

DIAGNOSIS.—At autopsy in infants not to be confused with: (1) Fibrous nodules on auriculo-ventricular valves at birth—common. (2) Small hæmatomata at valve edges, especially mitral: probably from rupture of valvular blood-vessels, shortly before or after death. Both groups disappear in early infancy.

Maldevelopments.—(1) General misplacement and anomalies; (2) Defects of the cardiac septa; (3) Anomalies and lesions of the valves; (4) Transposition of aorta and pulmonary artery; (5) Patency of fœtal passages; (6) Fallot's tetralogy; (7) Coarctation of aorta.

1. GENERAL MISPLACEMENTS AND ANOMALIES.—Often associated with various monsters—e.g., acardia, ectopia cordis.

DEXTROCARDIA.—Compatible with normal life; usually with complete transposition of viscera; rarely partial transposition; very rarely of heart only.

2. DEFECTS OF THE CARDIAC SEPTA.—

a. AURICULAR AND VENTRICULAR SEPTA BOTH ABSENT, partially or completely—i.e., *cor biloculare*: single vessel supplies systemic and pulmonary circulation.

b. DEFECTS OF INTERAURICULAR SEPTUM: Especially at foramen ovale.

Varieties of Defective Foramen Ovale.—

i. Membrane incompletely attached, leaving slit: normal for two to three months: no importance. Also minute fenestrations.

ii. Membrane deficient: (a) Without other defects: common: little importance. (β) Often with pulmonary stenosis and patent interventricular septum.

c. DEFECTS OF INTERVENTRICULAR SEPTUM: (i) Complete: *cor triloculare*: with some defects of arterial trunks. (ii) Partial: especially pars membranacea—'undefended space' (Roger's disease)—(the area of this is small, and deficiency almost always involves portions of the muscular septum).

Defective Pars Membranacea.—(a) Without other defects: compatible with fair life. (β) Often with other defects: pulmonary stenosis, patent ductus arteriosus.

3. ANOMALIES AND LESIONS OF THE VALVES.—Irregularities of the auriculo-ventricular valves are rare.

a. NUMERICAL IRREGULARITIES.—

i. Bicuspid Semilunar Valves.—Not very rare. Especially aortic valve. One valve normal and two united.

Maldevelopments of the Heart—The Valves, continued.

Important, since combined valve is thickened, becomes sclerosed, and aortic regurgitation results and is fatal. Etiology doubtful, whether mal-development or endocarditis.

ii. *Supernumerary Valves*.—Commonest is small fourth valve at pulmonary orifice. Little importance.

b. **LESIONS AT PULMONARY ORIFICE**.—Commonest congenital lesions to survive childhood, especially stenosis.

i. *'Congenital Pulmonary Stenosis', Stenosis of the Valves*.—Commonest surviving congenital lesion. Foetal endocarditis or maldevelopment causes fusion of valves and advanced stenosis. Usually very smooth. Valves may be normal, stenosis affecting region of infundibulum an inch or two below valves.

Associated defects: Patent ventricular septum, sometimes patent foramen ovale; pulmonary artery usually small and aorta dilated. Ductus arteriosus may be patent.

ii. *Atresia or Obliteration of Trunk of Pulmonary Artery*.—Rarer than above. Artery contracted or obliterated (forming fibrous cord) for varying length. Due to irregular division of common arterial trunk. Usually other defects present. Essential for life are patent ductus arteriosus and either patent ventricular septum or patent foramen ovale. Right heart is hypertrophied.

iii. *Stenosis of Conus Arteriosus*.—Not infrequent with stenosis at orifice. Often with patent ductus arteriosus, foramen ovale, or ventricular septum.

c. **LESIONS AT AORTIC ORIFICE**.—Rare. Stenosis and atresia occur. (See above, NUMERICAL IRREGULARITIES.)

d. **LESIONS OF MITRAL VALVES**.—Very rare.

4. **TRANSPOSITION OF AORTA AND PULMONARY ARTERY**.—Many varieties. Associated with various defects of chambers and septa. Occasionally cavities are normal. May be no symptoms and no murmur or hypertrophy.

5. **PATENCY OF FŒTAL PASSAGES**.—

a. **FORAMEN OVALE**.—See DEFECTS OF THE CARDIAC SEPTA.

b. **DUCTUS ARTERIOSUS**.—Associated with stenosis at pulmonary orifice, deficient ventricular septum, and other defects. Normally closed before fourteenth day of life.

6. **FALLOT'S TETRALOGY**.

7. **COARCTATION OF AORTA**.

General Symptoms.—(May be none: physical signs only.)

1. **CYANOSIS** ('*morbis cæruleus*', 'blue babies').—Classical symptom. Noticed at end of first week of life or later. Degree extreme. Generalized, or extremities only: often general duskiess of skin.

CAUSE OF CYANOSIS.—Partly: (1) Deficient aeration of blood in lungs; (2) Passage of unacrated blood from right heart

to arterial system. Probably both are factors: also *erythræmia* and excessive hæmoglobin. The tint is brightish blue, combining asphyxia and congestion.

2. **DYSPNŒA.**—May be paroxysmal. Tendency to cough and bronchitis.

3. **CLUBBED FINGERS.**—Often toes also. Nostrils and lips thickened.

4. **ERYTHRÆMIA.**—Red cells 7,000,000 to 10,000,000: also increased percentage of hæmoglobin.

Subjects small and weakly. Convulsions common. Surface temperature often low. May be epistaxis and hæmoptysis.

Congenital Pulmonary Stenosis.—

SYMPTOMS.—As in **GENERAL SYMPTOMS** Cyanosis due to associated defects. Commonest cause of 'blue babies'.

PHYSICAL SIGNS.—

1. *Systolic murmur*, maximum in second left space.

2. *Thrill, fine, systolic*, maximum in second left space, may be widely transmitted.

3. *Pulmonary second sound very weak*.

4. Area of cardiac dullness increased to right.

NOTE.—Thrill may be absent. Rarely pulmonary second sound loud: probably stenosis of conus arteriosus or pulmonary stenosis with widely patent ductus arteriosus.

Patent Ductus Arteriosus.—

SYMPTOMS.—When sole defect, no symptoms, no cyanosis, no clubbing.

PHYSICAL SIGNS.—Diagnostic when defect large:—

1. *Murmur of peculiar 'rushing' character*: maximum at 3rd left space, and conducted outwards; onset after clear first sound, but almost continuous, with systolic intensification (due to blood flowing from aorta to pulmonary artery).

2. *Pulmonary second sound 'accentuated'*: often reduplicated.

Less constant:—

3. Thrill: systolic or almost continuous; maximum in 2nd left space; if conducted towards clavicle (along pulmonary artery), is pathognomonic.

4. Dull area to left of sternum over dilated pulmonary artery (Gerhardt's ribbon-shaped area).

5. Pulsation in 2nd left space, and palpable shock of closing pulmonary valves.

RADIOGRAPHS.—Dilated conus arteriosus.

Patent Interventricular Septum (Maladie de Roger).—

SYMPTOMS.—None unless defect large, when cyanosis present. May be heart-block from defect in conducting tissues. Often as part of Fallot's tetralogy.

PHYSICAL SIGNS.—Harsh murmur, and may be thrill, from early systole into diastole; over mid or left sternum; not conducted into neck or axilla; second sound usually audible. (May be no signs.)

Congenital Affections of the Heart, continued.

Patent Interauricular Septum.—Usually no distinguishing features. If large : may be systolic murmur over sternum.

RADIOGRAPHS.—Enlarged right auricle and ventricle.

Fallot's Tetralogy.—

LESIONS.—(1) Pulmonary stenosis ; (2) Defect of interventricular septum (compensatory, relieving high pressure in right ventricle) ; (3) Dextraposition of aorta—communicates with both ventricles ; (4) Right ventricle hypertrophied. Due to failure of bulbus cordis to be incorporated in right ventricle.

SYMPTOMS.—Commonest cause of morbus cœruleus surviving into adult life, lesions partly mutually compensatory. Cyanosis, clubbing, polycythæmia, etc

PHYSICAL SIGNS.—Systolic thrill and murmur near sternum in left second and third spaces.

RADIOGRAPHS.—Distinctive 'cœur en sabot'. Apex is lifted away from diaphragm ; aorta increased to right ; right ventricle hypertrophied, concavity in region of pulmonary artery.

ELECTROCARDIOGRAM.—Right-sided preponderance.

Coarctation of the Aorta.—

TYPES.—These are two in number :—

1. **INFANTILE.**—Narrowing of entire isthmus between left subclavian artery and ductus arteriosus, which is patent, and through which blood enters aorta. Is persistence of foetal state. Incompatible with adult life. Not further referred to.

2. **ADULT.**—Constriction at or usually just below insertion of ductus arteriosus, which is closed : is extension of process which closes ductus arteriosus.

SYMPTOMS.—May be none : compatible with adult life. Symptoms from : cardiac weakness ; palpitation ; throbbing of arteries ; cold lower extremities Claudication rare.

PHYSICAL SIGNS.—

1. Anastomoses produce dilated and tortuous arteries—e.g. :
(i) Internal mammary and epigastric branches of external iliacs in abdominal wall ; (ii) Scapular branches of subclavians and aortic intercostals ; (iii) Superior intercostal branches of subclavians and aortic intercostals. Arteries visible on abdomen and along scapulæ.

2. Pulsation absent in abdominal aorta, and femorals.

3. Systolic murmur widely audible.

4. General cardiac hypertrophy.

5. Blood-pressure raised in arms ; absent or low in legs.

RADIOGRAPHS.—Notching of ribs due to enlarged intercostal arteries. Ascending aorta enlarged and knuckle small.

DEATH.—May occur from : (1) Cardiac failure ; (2) Rupture of heart or aorta ; (3) Cerebral hæmorrhage ; (4) Infective endocarditis.

Diagnosis.—Usually simple. Occur in children or from childhood. Presence of: (1) Cyanosis, (2) Systolic murmur: maximum intensity and conduction not corresponding to acquired murmurs. (3) Erythræmia. Usually, (4) Hypertrophy of right heart. Determination of exact lesion difficult.

Duration.—Congenital pulmonary stenosis passes twelfth year oftener than any other serious defect; rarely exceeds 25 years.

Fallot's tetralogy, and coarctation of aorta, may reach 40 years.

Pure defect of ventricular septum, patency of ductus arteriosus, some transposition of vessels, and various minor defects, may pass middle age.

Death from: (1) Cardiac failure; (2) Complications—e.g., bronchitis, tuberculosis, infective endocarditis, paradoxical emboli in lung or brain.

Treatment.—Hygienic. Protect against colds and over-exertion. Venesection for severe dyspnœa. For cardiac failure, as in acquired conditions.

CHAPTER CL.

ANGINA PECTORIS.

• Paroxysmal severe cardiac pain, associated with changes in aorta or coronary arteries.

Etiology.—

AGE.—Rarely under 50 years, except with syphilis.

SEX.—Rare in females.

OCCUPATION.—Mainly professional classes, acquainted with strain and worry.

PREDISPOSING FACTORS.—(1) *Sclerosis of coronary arteries*; (2) Syphilis, especially in cases under 40 years; (3) Arterio-sclerosis. Rheumatism, specific fevers, tobacco.

EXCITING CAUSES.—(1) Exertion; (2) Emotion; (3) Flatulence; (4) Chill.

Morbid Anatomy.—Causal conditions are:—

a. **SCLEROSIS OF CORONARY ARTERIES.**—Characteristically *obliterative endarteritis*: predominant lesion. Orifices alone may be narrowed.

b. **SYPHILIS.**—*Aortitis* above valves; aneurysm.

CARDIAC CONDITIONS commonly associated are ancillary to:
(i) *Fibroid myocarditis*; (ii) *Aortic incompetence*; (iii) *Syphilitic aortitis*; (iv) *Aortic aneurysm*. May be ischæmic necrosis.

Theories of Origin.—Three hypotheses: Disease of (1) coronary arteries, (2) base of aorta, (3) cardiac muscle.

SPASM OF CORONARY ARTERIES.—Causing interference with circulation, and transient ischæmia of the myocardium.

Angina Pectoris—Theories of Origin, *continued*.

ALLBUTT'S THEORY.—Pain due to inflamed coats of first part of aorta (aortitis): sudden death from vagal inhibition of heart caused by shock of pain.

MACKENZIE ascribes pain to cardiac exhaustion and susceptible nervous system.

The sense of constriction is probably spasm of the intercostal muscles, a protective spasm over an injured organ (Mackenzie); pain similarly a protective mechanism.

Symptoms.—*Exciting stimulus* invariably present. Onset usually during stimulus, occasionally delayed. Stimulus in same person often constant—e.g., exertion.

ONSET.—Sudden; rapidly attains maximum. Paroxysmal.

CHARACTERISTIC SYNDROME.—(a) *Severe continuous pain over heart*: often radiating in definite area (see DISTRIBUTION OF PAIN). (b) *Sense of constriction*: as if heart compressed in vice. (c) *Mental anxiety, fear of death*: *angor animi*.

OTHER IMPORTANT SYMPTOMS.—(d) *Subject never walks about*; always stops if walking. 'Waves aside' proffered assistance. Usually bends, with hand pressed over heart; motionless, or changing at intervals from one position to another. (e) *Vasomotor phenomena*: *face ashy grey*; cold sweat. (f) *Breathing* constrained by pain.

VARIOUS AND UNUSUAL SYMPTOMS.—*Fainting* uncommon; very rarely, transient paresis and aphasia. *Pulmonary symptoms*: Paroxysmal dyspnoea ('cardiac asthma') may occur; rarely, acute pulmonary oedema (very fatal). *Abdominal angina*: Occasionally pain entirely abdominal; diagnosis difficult.

Physical Signs.—Slight.

PULSE.—Variable; may be irregular; rapidity unusual.

HEART-SOUNDS faint.

BLOOD-PRESSURE high. Arteriosclerosis usual.

Distribution of Pain.—Often characteristic.

COMMON AREA AFFECTED.—*Precordial region, left axilla, inner surface of left arm, two inner fingers*. Pain commonly starts over heart and radiates thence; rarely commences elsewhere and spreads to precordium.

WIDER AREA NOT UNCOMMONLY AFFECTED.—Neck, left shoulder, left jaw; occasionally right shoulder; but right arm is rare.

TENDERNESS.—Hyperæsthesia common in area of pain. May be numb feeling.

AREAS OF CORD AFFECTED.—Dorsal 1-4; also cervical 7-8; may involve dorsal 5-9.

Note.—Between attacks, and also in other cardiac conditions, tenderness often found on lightly pinching left sternomastoid, trapezius, pectoralis major (Mackenzie).

Duration of Attack.—A few seconds to one to two minutes.

Electrocardiogram.—May resemble coronary thrombosis during attack. Returns to normal, but usually evidence of myocarditis

Terminations.—

1. **SUDDEN OR RAPID CESSATION.**—Common ending. Often passage of flatus or urine. Patient usually exhausted for several days, but sometimes no such after-effects.
2. **RECURRENCES.**—Attacks may follow rapidly for one to two hours. Rapid cardiac failure.
3. **SUDDEN DEATH.**—Always feared and possible. May occur in first attack, or after many years of recurrence.

Recurrence of Attacks.—May recur for many years. In younger syphilitic cases, cessation has occurred

Mild Attacks.—Substernal oppression or milder pains may occur. In persons subject thereto, such attacks, occurring during exertion, may act as warning, and immediate rest may abort severe attack.

Prognosis.—

1. **IMMEDIATE PROGNOSIS IN ATTACK.**—Occurrence of sudden death is rare compared with number of attacks, but may occur at any time
2. **REMOTE PROGNOSIS.**—(i) Syphilitic cases under 40 years: treatment may effect great improvement. (ii) Attacks following exertion, with advanced arteriosclerosis and high blood-pressure: prognosis most serious. (iii) Following emotion: less serious

Diagnosis.—Severe cardiac pain occurs in.

1. Coronary thrombosis
2. Vasomotor angina Prolonged duration.
3. Syphilitic aortitis and aneurysm
4. Intercostal pain due to herpes, pleurisy, neuritis, etc
5. Effort syndrome
6. Cardiac pain rarely from other causes, e.g., tobacco, rheumatic fever. Also.—
7. Abdominal colic, e.g., gall-bladder

Treatment.—

1. **DURING ATTACK.**—Amyl nitrite inhaled: capsule 3 to 5 minims; may need several. If flatulence, hot peppermint-water and carminatives. If recurrent, inject morphia gr. $\frac{1}{2}$ and atropine gr. $\frac{1}{100}$. In great severity, chloroform anaesthesia. With signs of cardiac and respiratory failure, give stimulants, brandy or spiritus aetheris 5j, with spiritus ammoniae aromaticus 5j, in a little water. If cyanosis marked, oxygen.
2. **BETWEEN ATTACKS**—Of highest importance. As in compensated cardiac conditions (*see* p. 822). If blood-pressure high, pot. iodide gr. x and liq. trinitrini ℥j, t.d.s. Treat flatulence and dyspepsia especially.

SYPHILITIC CASES.—Antisyphilitic remedies.

Division of cardiac sensory nerves is under trial, e.g., cervico-thoracic sympathetic (Jonnesco).

VASOMOTOR-ANGINA*(Cardiac Neurosis.)*

Subjects usually exhibit marked vasomotor phenomena: blue extremities, cold clammy hands. Also evidence of neurosis. Onset of attack probably connected with vasomotor constriction of peripheral vessels and increased intraventricular pressure.

Note.—The term 'pseudo-angina' is sometimes used. It is also employed for pains due to abdominal organic lesions.

Pain, in type, severity, and distribution, may resemble severest angina major, but more often *less extreme*. Types are differentiated rather by extracardial symptoms.

General Characteristics (cf. TRUE ANGINA).—

FEMALES commoner.

NEUROTIC and hysterical factor present. Often weak family history. Occasionally: excessive tobacco; acute infections, especially influenza.

NO ORGANIC LESIONS. Blood-pressure often high.

EXCITING STIMULI less definite: may be faintness and feeling of cold preceding pain.

ONSET less abrupt.

DURATION may be one or more hours.

WALKS ABOUT RESTLESSLY DURING ATTACK. **GREAT**

MENTAL EXCITEMENT.

NEVER FATAL.

Diagnosis from severe angina usually possible on the above points.

CHAPTER CLI.**CORONARY THROMBOSIS.**

Thrombosis of the coronary artery produces sudden severe sternal pain with certain characteristics.

Etiology.—

SEX.—Males predominate.

AGE.—Usually 60 to 70 years.

Associated with arteriosclerosis and high blood-pressure.

Morbid Anatomy.—Thrombosis of arteriosclerotic coronary arteries. Infarct develops; pericarditis on surface. If survival long enough, ischæmic necrosis, followed by fibrosis of heart muscle. Rarely, aneurysm or rupture of heart occurs.

Symptoms.—Previous slight pain on exertion in sternum or arms; may be absent.

ONSET OF MAIN ATTACK.—Sudden pain in chest (or upper abdomen): may occur *while at rest*: not paroxysmal, constant for hours or days.

CONDITION DURING ATTACK.—Restless. Expression anxious and ashen; perspires. Dyspnoea and cyanosis in some degree. Vomiting usual after onset. Temperature normal. Pulse rapid and soft: often irregular (extrasystoles, fibrillation, etc.): all signs of heart disease may be absent.

PROGRESS IN ATTACK.—Temperature: slight rise for few days. Blood-pressure: steady fall. Pericardial friction may become audible. *Leucocytosis*.

Course.—May be:—

1. Immediate death. About 50 per cent.
2. Gradual convalescence.

Subsequently: May be years without recurrence. Usually, pain on exertion, shortness of breath. Tendency to cardiac failure remains, and many die within 3 years.

Electrocardiogram.—

AT ONSET.—R-T segment forms plateau in Lead I and depression in III; or vice versa.

LATER—R-T returns to normal. Large T waves, inverted in I or III, but not both. Associated changes of myocarditis, bundle-branch block, etc.

Diagnosis.—Differs from angina pectoris in: (1) Onset while at rest; (2) Duration; (3) Restlessness; (4) Dyspepsia and vomiting common; (5) Nitrites no effect; (6) Pulse rapid, soft, and irregular; (7) Blood-pressure falls. May simulate abdominal disease.

Treatment.—Rest in bed four to eight weeks. Slow convalescence. **DURING ATTACK.**—Morphia relieves, in large doses. Nitrites contra-indicated.

CHAPTER CLII.

ARTERIOSCLEROSIS.

Thickening and degeneration of the arterial coats, local or general. Includes various pathological and clinical types.

Etiology.—Difficulty results from undoubted fact that several factors may be either the cause or result of arteriosclerosis. Consider the three closely associated conditions, high blood-pressure, arteriosclerosis, and chronic interstitial nephritis. Arteriosclerosis, of any origin, usually results in high blood-pressure and chronic nephritis: conversely, it may result from high pressure or chronic nephritis. Further, different factors produce different types of arteriosclerosis. Influence of internal secretions, e.g., suprarenal, is at present uncertain. Main factors resulting in arteriosclerosis are:—

1. **HIGH BLOOD-PRESSURE.**—See p. 840.

(*Pathological types:* Diffuse arteriosclerosis; also atheroma.) Influence of high pressure on arteriosclerosis proved by:

- (i) Rare occurrence in pulmonary arteries; (ii) Occurs in pulmonary arteries when pressure is high, e.g., in mitral

Arteriosclerosis—Etiology, *continued*.

- stenosis; (iii) Frequency at points of strain, viz., arch of aorta, orifice of branches.
2. **SENILE INVOLUTION CHANGES.**—In old age almost invariable. Sometimes at younger ages: frequently an hereditary or familial condition.
(*Pathological type*: Senile arteriosclerosis—viz., Mönckeberg's medial degeneration; also is factor in atheroma.)
 3. **CHRONIC NEPHRITIS.**—Three groups:—
 - a. Chronic interstitial nephritis: red granular contracted kidney
 - b. Chronic glomerulo-nephritis: small white kidney (late stages).
 - c. Arteriosclerotic kidney. (Also classifiable as Essential Hypertension under HIGH BLOOD-PRESSURE p. 840.)
(*Pathological types*: Atheroma, diffuse arteriosclerosis.)
 4. **CHRONIC INTOXICATIONS.**—Especially *lead*, *tobacco*, and *gout* (traditional causes: doubtful as single factors.)
(*Pathological types*: Atheroma, diffuse arteriosclerosis.)
 5. **SYPHILIS.**—Action on arteries of highest importance, but causes neither true atheroma nor diffuse arteriosclerosis.
(*Pathological types*: Mesaortitis and aneurysm, periarteritis, and obliterative endarteritis.)

Morbid Anatomy.—Types: (1) Nodular, or atheroma; (2) Diffuse; (3) Senile; (4) Endarteritis; (5) Periarteritis; (6) Syphilitic (considered here for convenience). The types may be coexistent.

1. **NODULAR ARTERIOSCLEROSIS (Atheroma).**—

VESSELS AFFECTED.—Aorta and main branches, coronary and cerebral arteries.

FACTORS.—High blood-pressure, liability increasing with age.

May be hypercholesterolaemia. Syphilis is not a factor.

HISTOLOGY.—Earliest change, localized hypertrophy of intima. Then fatty degeneration in deeper layers of intima and also media, and *impregnation with lime salts*.

MACROSCOPIC APPEARANCE.—Early: slightly raised yellow patches. Later: firm 'plaques'.

SUBSEQUENT CHANGES.—(a) Mass softens, forming *atheromatous abscess*; (b) Abscess ruptures in lumen, forming *atheromatous ulcer*.

SEQUELÆ may be: (a) Thrombus forms on surface, occluding narrowed artery; (b) Dissecting aneurysm.

2. **DIFFUSE ARTERIOSCLEROSIS** (Jores's intimal hypertrophy, 'arterio-capillary fibrosis' of Gull and Sutton, or 'diffuse hyperplastic sclerosis').—

VESSELS AFFECTED.—Larger vessels tend to escape. Primarily affects arterioles and smaller arteries, especially in kidney, spleen, and brain. Radial arteries firm and 'whipcord'.

FACTORS.—Essentially the type occurring with high blood-pressure, cardiac hypertrophy, and chronic interstitial nephritis. *Age*: rare under 35 years and in extreme old age. Syphilis is not a factor.

HISTOLOGY.—Vessels thickened and tortuous: lumen diminished. *Intima*: thickening and hyaline degeneration (earliest change); later fatty degeneration. *Elastic lamina*: thickened; often splitting of several laminae. *Media*: hypertrophy. *Adventitia*: fibrous tissue increased.

3. **SENILE ARTERIOSCLEROSIS** (Mönckeberg's medial degeneration or sclerosis).

VESSELS AFFECTED—General distribution; radial, tibial, and femoral arteries most marked; *resemble clay pipe-stems*. Large arteries also hard and tortuous.

FACTORS—Essentially a senile change. Blood-pressure about normal and cardiac hypertrophy not associated. *Age*: rare under 50 years; increases with age. Syphilis is not a factor.

HISTOLOGY—Fatty degeneration of media, and, later, calcification are characteristic changes; intima little affected. In aorta, calcareous plaques or slighter diffuse calcareous areas. Atheroma usually coexists.

Note—Mönckeberg's sclerosis, so far as fatty degeneration of media, occurs also at younger ages in various debilitating conditions, e.g., carcinoma, tuberculosis, diabetes, chronic infections, and cardiac lesions

4. **ENDARTERITIS**.—Affects small vessels. In syphilis and tuberculosis. *See below*.

5. **PERIARTERITIS**.—Affects small vessels. In syphilis, poli-encephalitis, and encephalitis lethargica.

6. **SYPHILITIC DISEASES OF ARTERIES**.—Syphilis is not a cause of true atheroma, and only of localized arteriosclerosis. The morbid anatomy is dealt with here for convenience.

AORTA.—A *mesaortitis*: essential changes are in media. Commonest lesion of acquired syphilis found at autopsy: is proof of syphilis. Also occurs rarely in congenital syphilis. *Spirochæta pallida* has been found (Levaditi's method). Wassermann reaction always positive.

Macroscopic Changes.—Localized, usually near root of aorta. Numerous depressed short linear or stellate scars. Rest of aorta generally normal.

Histology.—Early: (i) Perivascular infiltration of vasa vasorum extending into media; (ii) In affected areas of media, infiltration with plasma cells, degeneration of muscle cells. Later: Fibrosis of areas in media; subsequent contraction produces the linear scars.

Intima over areas may degenerate and calcify ('syphilitic atheroma'). Localized gummata are extremely rare.

Sequelæ.—Aortic valvular lesions. Aortic aneurysms.

SMALLER ARTERIES.—Two types:—

- i. *Obliterative endarteritis*.—Proliferative thickening of intima; elastic lamella remains unchanged and easily recognized. Later, granulation tissue forms and

Arteriosclerosis—Syphilitic Diseases of Arteries, continued.

fibroses. Thickening may entirely fill lumen. *Similar changes occur in tuberculosis.* Giant cells occur in both forms: commoner with tubercle.

- ii. *Periarteritis*.—Particularly in arterioles of brain and cord. *Adventitia* thickened and infiltrated; later, may become hyaline and fibrotic. Thickening of intima may coexist. *Spirochæta pallida* has been found. Condition almost *specific of syphilis*, and marked in chronic syphilitic lesions of central nervous system.

Symptoms.—Characteristic syndrome of diffuse arteriosclerosis: Middle-aged man complains of giddiness, and slight impairment of memory; arteries thickened, blood-pressure high, left ventricle hypertrophied, aortic second sound accentuated, mitral first sound roughened. Symptoms are varied, and depend on system mainly affected:—

1. **CARDIAC.**—*Sclerosis of the coronary arteries*, its sequelæ, and *ancillary conditions*, provide symptoms, viz.: (a) Fibroid myocarditis; (b) Abnormal rhythms; (c) Cardiac failure; (d) Angina; (e) Coronary thrombosis and sudden death. Valvular lesions, especially *aortic incompetence*, may result.
2. **CEREBRAL.**—(a) *Vertigo*—most frequent symptom; headache. (b) Progressive dementias; all grades from *deficient memory* to dementia. (c) Cerebral hæmorrhage. (d) Transient pareses and aphasia; ascribed to transient spasm in narrowed arteries: (c) Hypertensive cerebral attacks.
3. **RENAL.**—Symptoms of chronic nephritis. Either (a) red granular kidney, (b) small white kidney (late stages), or (c) arteriosclerotic kidney.

VARIOUS SYMPTOMS.—

INTERMITTENT CLAUDICATION.—No symptoms when patient is at rest: exertion is followed by pain and tingling in legs, and, when severer, by cramp, weakness, and paresis. Ascribed to ischæmia, blood-supply being insufficient for increased work (cf. *ANGINA*). Vasomotor changes common: coldness and congestion; dorsal arteries of feet may be pulseless. Special factors: tobacco, syphilis.

GANGRENE OF EXTREMITIES.—From endarteritis obliterans or thrombosis.

ABDOMINAL ARTERIOSCLEROSIS.—Sclerosis of splanchnic vessels and subsequent spasm has been given as cause of lead colic and tabetic crises: possibly also cause of 'abdominal angina'.

RETINÆ.—Arteries thickened, glistening line of light along centre, i.e., 'silver wire arteries'; compress veins when crossing, causing peripheral distension. May be flame-shaped hæmorrhages.

Diagnosis.—Note: (1) Thickened arteries (examine the brachial in addition to the smaller arteries); (2) High blood-pressure; (3) Hypertrophy of left ventricle; (4) Condition of urine; (5) Radiographs—senile type.

Prognosis.—Depends mainly on efficiency of heart and kidneys.

Treatment.—General hygienic life (*see* p. 822). For HIGH BLOOD-PRESSURE, *see* p. 840; also RED GRANULAR CONTRACTED KIDNEY, p. 662.

Sclerosis of the Pulmonary Artery (*Ayerza's Disease*).—Atheroma and sclerosis of the pulmonary artery and main branches.

ETIOLOGY.—

1. Secondary to high pressure due to diseases of (a) lungs, e.g. chronic bronchitis and emphysema, (b) heart, e.g., mitral stenosis.
2. Syphilis.
3. Primary non-syphilitic; especially in India.

MORBID ANATOMY.—

PULMONARY ARTERY.—Dilated, may be aneurysmal; atheroma extending into main branches.

HEART.—Right ventricle hypertrophied and dilated.

SYMPTOMS.—Onset insidious: often long pulmonary or cardiac stage.

1. **RESPIRATORY.**—Cough, dyspnoea; expectoration; may be hæmoptysis. Clubbing of fingers common.
2. **CYANOSIS**—Of face and neck, extreme.
3. **ERYTHROCYTOSIS.**—5 to 10 million red cells.
4. **RADIOGRAPHS.**—Pulmonary artery prominent; branches in lung may be visible; arc bulges on left.

WASSERMANN REACTION.—May be positive.

TREATMENT.—(1) For erythrocytosis (*see* ERYTHRÆMIA, p. 727).

(2) Syphilis.

PROGNOSIS.—Death from cardiac failure. Duration: few years.

Sclerosis of Veins (*Phlebosclerosis*).—Not uncommon in arterio-sclerosis and with high blood-pressure. Occurs in pulmonary veins in mitral stenosis. Intima thickened.

CHAPTER CLIII.

ALTERATIONS IN BLOOD-PRESSURE.

Variations of blood-pressure occur in many diseases, but also without obvious cause.

Note.—Pressure rises temporarily with exercise and emotion (sometimes falls), and estimation should be repeated until constant.

Factors maintaining Arterial Pressure.—

1. **HEART.**—Strength of contraction of left ventricle.
2. **VOLUME OF BLOOD ENTERING AORTA.**
3. **CONDITION OF ARTERIES.**—Especially elasticity.
4. **PERIPHERAL RESISTANCE.**—Vasomotor tone.
5. **CONDITION OF BLOOD.**—Viscosity and volume.

Alterations in Blood-pressure, *continued*.

Normal Pressure.—It is impossible to give a figure which is normal for all healthy persons. The layman believes that it is 100 plus the age. There is no evidence of rise between 18 and 40 years.

SYSTOLIC PRESSURE IN ADULTS.—Average, 100 mm. Hg, plus about two-thirds of age in years.

DIASTOLIC PRESSURE IN ADULTS.—About two-thirds of systolic: proportion lower in later life.

High Pressure.—Over 160 mm. systolic and 90 mm. diastolic in adults. In children and adolescents, over 140 mm. systolic. No risk of hæmorrhage under 170 mm. systolic. Over 130 mm. diastolic is serious.

Low Pressure.—Systolic pressure under 110 mm. Hg.

HIGH BLOOD-PRESSURE.

(*Hypertension*.)

Permanent High Pressure.—Occurs in:—

1. **ESSENTIAL HYPERTENSION: HYPERPIESIA.**—*See* p. 841.
2. **HYPERTROPHY OF LEFT VENTRICLE.**
3. **RENAL DISEASE.**—(1) In all forms of 'contracted kidney'—viz., primary small white, secondary small white (later stagcs), arteriosclerotic, and red granular kidney; (2) In varying less severe degree in later stage of large white kidney. *Present temporarily* in acute diffuse nephritis, kidney of pregnancy.

Absent in nephrosis, and may be absent or slight in nephrotic stage of diffuse glomerulo-nephritis. Renal diseases undoubtedly result in high pressure, though extirpation of kidney does not produce it.

4. **ARTERIOSCLEROSIS.**—Except in Mönckeberg's medial degeneration.

Note.—The last three factors may coexist.

5. **ENDOCRINE GLAND DISTURBANCES.**—(Many obscure factors.)

a. Menopause: may be transient or permanent.

b. Suprarenal tumours and hyperplasia. (Latter may be secondary to pituitary lesions.)

c. Thyroid toxæmia.

6. **BLOOD CONDITIONS.**—Increased viscosity or volume, e.g., erythrocytosis.

7. **INCREASED INTRACRANIAL PRESSURE.**—Following cerebral hæmorrhage. With œdema: uræmia or eclampsia.

8. **OBESITY.**

No evidence that high pressure is produced by: (a) Alcohol; (b) Chronic constipation and intestinal toxæmia (hypotensive common); (c) Infections and dental sepsis; (d) Syphilis.

Transient High Pressure.—Occurs with: (1) Exercise—5 to 10 minutes; (2) Emotion—duration varies (systolic only); (3) Acute nephritis—few weeks; (4) Onset of uræmia and eclampsia; (5) Menopause—months or years.

ESSENTIAL HYPERTENSION.*(Hyperpiesia.)*

This term designates a permanent high pressure not initially related to cardiac or vascular disturbances. Relation to renal changes doubtful.

Etiology.—Groups have been described as dependent on:—

1. **HEREDITY OR A CONSTITUTIONAL FACTOR.**—Short-set persons, short thick neck, high colour, plethoric type: energetic and capable; pressure 170–200 mm., rarely higher: probably the only type to which hyperpiesia is properly applied. A pale and asthenic group is described, but renal features are usually prominent.

2. **RESULT OF OVER-STRESS AND EMOTION.**

3. **EXCESSIVE DIET.**—Especially protein.

4. **EXOGENOUS TOXIC FACTORS.**—Lead and tobacco: usually accepted, but probably initially arterial. Alcohol: no proof.

AGE.—Commonest at 45 to 60 years. In children and young adults, renal disturbances quickly recognizable.

SEX.—Male and female equally affected.

The condition is open to discussion both as to its existence as an original entity (as described by Clifford Allbutt), and its relation to renal lesions. Many authorities consider it identical with arteriosclerotic kidney, which some believe to be essentially non-renal (i.e., hyperpiesic) in origin, and others believe to be essentially renal. Coexistence is undoubted for terminal stages—viz., material at autopsy. Identity at onset is less definite, but equally arguable on both sides. Symptoms as described here apply to early stages: for progress and full course, see **ARTERIOSCLEROTIC KIDNEY**, p. 657.

Symptoms.—Headache, vertigo, fullness in the head, difficulty in concentration, tinnitus, dyspnoea on exertion, cardiac discomfort. May be epistaxis, tingling in limbs. May resemble neurasthenia. May be no symptoms and high pressure found accidentally.

ARTERIES.—Often small and contracted. High pressure often unrecognized until tested.

PHYSICAL SIGNS.—Depend on duration: *cardiac hypertrophy* always develops.

Prognosis.—Varies with many factors: (1) Age—more acute at younger ages; (2) Family history of cerebral hæmorrhage, etc.; (3) Height of pressure—serious over 120 diastolic or 220 systolic; (4) Condition of arteries and heart—e.g., angina. Often lasts many years.

Treatment.—Reduction of pressure below 170 mm. is both difficult and inadvisable.

1. **MENTAL AND PHYSICAL REST.**—Rarely advisable to stop occupation permanently and completely.

2. **GENTLE EXERCISE.**—Spa treatment often satisfactory.

Essential Hypertension—Treatment, continued.

3. **DIET.**—Reduction in calories and moderately in protein—e.g., 40 to 50 gm. for 140-pound subject. Poultry and fish and egg: once daily. No red meat. Vegetables and fruit freely. Vegetarian diet if overweight. Strict salt-free diet not advisable. No alcohol. No tobacco.
4. **FLUID.**—Urine volume should be 50 to 60 oz.
5. **BOWELS.**—Saline aperients. Colonic irrigation: once a week.
6. **VASODILATORS.**—Nitroglycerin: tab. trinitrini gr. $\frac{1}{10}$ t.d.s.; tab. glyceryl. trinitrat. gr. $\frac{1}{10}$, t.d.s. Sodium nitrite gr. ij-iv t.d.s. Potassium iodide. Many special drugs, e.g., theominal.

BLOOD-LETTING.—Of special value in plethoric hyperpiesic type. May be repeated every six months: remove 10 to 25 oz. Improves symptoms but no obvious effect on pressure.

LOW BLOOD-PRESSURE.*(Hypotension.)***Permanent Forms.—**

1. *Constitutional*: asthenic, hypotonic, visceroptotic, debilitated types.
2. Disease of suprarenal glands (q.v.).
3. Myocardial degeneration.
4. Chronic anæmia.

Temporary Forms.—Systolic pressure usually falls more than diastolic.

1. Depletion of blood: hæmorrhage or diarrhœa.
2. Shock and collapse.

Symptoms in Permanent Forms.—Vague: exhaustion, dizziness on stooping, insomnia.

Treatment.—

TEMPORARY FORMS.—(1) Blood transfusion or saline injections; (2) Injection of adrenalin (1-1000 solution) $\frac{1}{5}$ to $\frac{1}{5}$ —transient effects.

PERMANENT FORMS.—Symptomatic.

CHAPTER CLIV.**ANEURYSM.**

A tumour containing blood or blood-clot and communicating directly with an artery or with the heart.

Classification.—

1. **TRUE ANEURYSM** (wall formed by one or more coats of the artery):—

DILATATION or FUSIFORM ANEURYSM.—Entire circumference involved.

DISSECTING.—Blood extends between the coats. Rare.

SACCULAR.—Common type. A cavity arising from portion of the circumference, with aperture commonly smaller than greatest diameter of cavity.

CIRROID.—Dilatation of entire artery and its branches. Limited to small vessels.

2. **FALSE ANEURYSM** (communicates with an artery, but wall not formed by arterial coats).—Hæmatoma from wound or rupture of artery.
3. **ARTERIOVENOUS ANEURYSM.**—Direct communication between an artery and vein.
4. **VARIOUS.**—Parasitic; 'traction' aneurysm.

Etiology of True Aneurysms.—

AGE.—Especially 30 to 45 years. A small group in elderly men.

SEX.—Males 5 or 10 to female 1.

PREDISPOSING CAUSES.—

1. **SYPHILIS.**—Syphilitic mesaortitis is predominant lesion and origin of aneurysms. Almost invariably present. Wassermann reaction always positive.

2. **ARTERIOSCLEROSIS.**—A small group occurs in elderly men, upwards of 50 years, without syphilitic mesaortitis (usually negative Wassermann reaction) but with marked atheroma.

STRAIN.—Influence uncertain. Aneurysms have followed chest-blows. May be exciting cause of rupture of coats when above factors are present; of no avail in their absence.

RARE CAUSES.—Infective emboli, usually multiple, in infective endocarditis. Tuberculous focus in wall of artery (very rare). 'Traction' aneurysm arising at ductus arteriosus very rare).

NUMBER.—Usually single; rarely two or more.

SITE (in order of frequency).—(1) Thoracic aorta: especially ascending and transverse portions of arch. (2) Popliteal artery: of surgical importance only. (3) Abdominal aorta and iliac arteries. Other vessels rare.

DEVELOPMENT OF ANEURYSM.—Intima atrophies or yields over area of mesaortitis, or rarely of arteriosclerosis. Pressure of blood (often high) extends dilatation. Growth of sac is opposed by: (1) Remaining tissues of wall; (2) Neighbouring structures; (3) Formation of thrombi. Sac by pressure destroys all resisting tissues, especially bone; intervertebral discs often remain after destruction of vertebræ (possibly from avascular nature).

FORMATION OF THROMBI IN SAC.—White thrombi deposited in successive layers; may be numerous. Harden with time; may be partial calcification; never organization.

ANEURYSM OF THE THORACIC AORTA.

DILATATION OR FUSIFORM ANEURYSM.

Site.—Ascending arch; occasionally entire arch.

Etiology.—Most common in elderly arteriosclerotic group.

Symptoms.—(1) Latent—not uncommon; (2) Coexistent aortic incompetence (either from stretching or simultaneous disease of valves); (3) Angina pectoris. Erosion of bone and pressure effects unusual.

Dilatation or Fusiform Aneurysm of the Aorta, *continued*.

Physical Signs.—(1) *Pulsation* in suprasternal notch, rarely in 1st and 2nd right spaces; (2) *Dullness* over and to right of manubrium; (3) *Loud aortic second sound*, or diastolic murmur, conducted upwards; (4) *X rays*.

Diagnosis.—Often not made, especially in absence of X rays.

DISSECTING ANEURYSM.

Very rare. Intima splits at weak spot, from syphilitic mesaortitis or arteriosclerosis, and blood spreads between coats. Extent variable: may form double tube for length of thoracic aorta. Split usually in ascending aorta.

Symptoms.—With large split, may be sharp pain at onset.

SEQUELÆ.—(1) Complete rupture of aorta and sudden death; inevitable if blood reaches adventitia. (2) No symptoms: adventitia and remains of media resist blood-pressure; forms 'healed dissecting aneurysm'; occasionally lined by intima.

Duration may be years.

Other Allied Conditions.—

RUPTURE OF THE AORTA.—Usually complete transverse. A cause of sudden death. Etiology: syphilitic or arteriosclerotic.

RUPTURE OF INTIMA ALONE.—May heal completely.

SACULAR ANEURYSM.

The most common type. The aorta is in propinquity to many important structures, and changes its relations rapidly, aneurysms thus producing a complexity of serious symptoms and signs. Aneurysms at the various sites are briefly considered first. A summary of physical signs and symptoms follows.

Consideration according to Site.—(1) Sinuses of Valsalva; (2) Ascending, (3) Transverse, and (4) Descending portions of the arch; (5) Descending thoracic aorta.

1. **ANEURYSM OF THE SINUSES OF VALSALVA.**—Not uncommon. Usually in young syphilitics. Is a cause of sudden death, by perforation into pericardium, rarely into auricle or superior vena cava.

SYMPTOMS.—(a) *Latent*; (b) Angina; (c) Those of coexistent aortic incompetence.

PHYSICAL SIGNS.—None localizing (very rarely presses on inferior vena cava, with congestion and œdema below diaphragm).

2. **ANEURYSM OF THE ASCENDING ARCH.**—

Anatomy.—Aorta arises at lower border of 3rd costal cartilage slightly to left of mid-line, and ascending arch terminates at upper border of 2nd right costal cartilage close to sternum; here separated from chest wall only by superior mediastinum, and partly overlapped by right lung and pleura. Length about $2\frac{1}{2}$ inches.

ORIGIN, AND DIRECTION OF EXTENSION.—Commonly arises from convexity, and extends forwards, eroding ribs and forming external tumour in 2nd and 3rd right space. Less often extends outwards on to lungs. Very rarely arises from concavity, extending to left of sternum.

PREDOMINANT FEATURE.—*Physical signs, directly due to the tumour.* Owing to anatomical relations, both symptoms and pressure signs are usually slight.

SYMPTOMS.—(a) Pain: from slight to angina (if origin near valves). (b) Cough: paroxysms rarely. May be slight hæmoptysis.

PHYSICAL SIGNS.—Characteristic are: (a) Expansile pulsating tumour to right of sternum. (b) Accentuated aortic second sound, or diastolic murmur—i.e., *normal* second sound is strong evidence against aneurysm in this position. (c) Diastolic shock and sound over sac (important but not very common). (d) Systolic *thrill* and murmur over sac. Less definite. (e) Dull area (in absence of tumour). (f) Heart may be dislocated down to left. Unusual: Dilated veins and œdema from pressure on deep veins; inequality of pupils and pulse. Rare: Pressure on recurrent laryngeal nerve.

DEATH.—Usually from cardiac or intercurrent disease. About one-third rupture, generally into right pleura, rarely external into pericardium or superior vena cava.

3. ANEURYSM OF THE TRANSVERSE ARCH.—

Anatomy.—Transverse arch commences at upper border of 2nd right costal cartilage, arches across 3rd dorsal vertebra, with apex $1\frac{1}{2}$ inches below sternal notch, and passing to the left and backwards, ends at left of upper border of 4th dorsal vertebra. Crosses bifurcation of trachea, œsophagus, and thoracic duct; is *crossed* by left recurrent laryngeal, vagus, and phrenic nerves; below are left bronchus and pulmonary artery.

ORIGIN, AND DIRECTION OF EXTENSION.—Usually from posterior wall, extending backwards. Less often forwards to right of sternum, from anterior wall. Rarely downwards from concavity. Sac may include innominate or carotid artery.

PREDOMINANT FEATURE.—*Symptoms, due to pressure* (often severe even if sac small).

SYMPTOMS.—(a) Alterations of voice. (b) Cough, 'bovine' or 'brassy'; often paroxysms. (c) Dyspnoea; often paroxysms. Occasionally: (d) Hæmoptysis. (e) Dysphagia.

PHYSICAL SIGNS (often slight).—(a) Suprasternal pulsation. (b) Laryngeal paralysis. (c) Inequality of pupils. (d) Inequality of pulses. (e) Tracheal tugging. Occasionally: Dilated veins and œdema from pressure on veins; dullness over manubrium. With aneurysms extending downwards and pressure on bronchus: Bronchitis; bronchiectasis; collapse of lung, etc.

DEATH.—(a) Rupture, into trachea, pleura, etc. (b) Tracheal compression.

Saccular Aneurysm of the Aorta, *continued*.

4. ANEURYSM OF THE DESCENDING ARCH.—Rarer than previous sites.

Anatomy.—Descending arch commences at upper border of 4th and ends at lower border of 5th dorsal vertebra. *In front*, root of left lung; *to right*, œsophagus; *to left*, left lung and pleura; *behind and to right*, bodies of 4th and 5th vertebræ.

DIRECTION OF EXTENSION.—Mainly backwards and to left.

PREDOMINANT FEATURES.—Arise from: (a) Pressure on lung structures; (b) Erosion of vertebræ; (c) Erosion of ribs posteriorly.

SYMPTOMS.—Often latent until rupture occurs. (a) *Pain* often referred to abdomen; severe after erosion of vertebræ and pressure on roots. (b) *Cough*. (c) *Dysphagia*. Occasionally: (d) *Transverse myelitis*.

PHYSICAL SIGNS.—(a) Posteriorly, in left interscapular space, pulsating tumour or dullness; systolic murmur. (b) *Bronchitis*, *bronchiectasis*, *collapse*, etc., from pressure on bronchus. (c) *Transverse myelitis*; increased knee-jerks. *Babinski sign*, etc.

DEATH.—Rupture into pleura common.

5. ANEURYSM OF THE DESCENDING THORACIC AORTA —. Uncommon.

Anatomy.—From lower border of 5th dorsal vertebra to aortic opening in diaphragm over 12th dorsal vertebra, almost in mid-line. *Is crossed* right to left by œsophagus, separating it from heart and pericardium.

ORIGIN, AND DIRECTION OF EXTENSION.—Usually close to diaphragm. Erosion of vertebræ common. Sac often very large.

SYMPTOMS.—Often latent. (a) *Pain*; often referred to abdomen; severe after erosion of vertebræ and pressure on roots. (b) *Cough*. (c) *Dysphagia*. Occasionally: (d) *Transverse myelitis*.

PHYSICAL SIGNS.—(a) *Pulmonary*. (b) *Œsophageal obstruction*. Rarely: (c) *Pulse absent below sac*. (d) *Transverse myelitis*.

DEATH.—Rupture common into pleura, also into lung; occasionally into pericardium, œsophagus, etc.

Physical Signs.—(1) Signs directly connected with the aneurysm; (2) Signs due to pressure of the sac on other structures.

1. SIGNS DIRECTLY CONNECTED WITH THE ANEURYSM.—Vary with position, thickness of wall, amount of clot, and condition of heart. Especially marked in aneurysms of ascending arch.

INSPECTION AND PALPATION.—(a) At site of aneurysm: (i) *Pulsation*: characteristic if *expansile*. (ii) *Diastolic shock* (ascending arch). (iii) *Systolic thrill*. (b) *Position of apex beat*. Usually normal, but displacement occurs from: (i) *Heart dislocated*: only by sacs from ascending arch. (ii) *Hypertrophy*: not common: results from coexistent (a) aortic incompetence, or (β) arteriosclerosis.

Saccular Aneurysm of the Aorta—Pressure Signs, *continued*.

with large sacs, no pulse in abdominal aorta and below.

Fallacious effects arise from: (i) Stiff-walled sac with much clot; expansion slight, and pulse may be normal.

(ii) Emboli: e.g., clot from ascending arch sac may lodge in left subclavian artery and diminish left pulse.

Conclusion.—Inequalities of radial pulses are common, simple, and valuable evidence of aneurysm, but uncertain as evidence of localization. They may be absent.

Blood-pressure.—There may be a difference of 20 to 30 mm. between the two brachials.

c. **INEQUALITY OF PUPILS**.—Causes are:—

i. Lower carotid pressure on one side, resulting in contraction of spiral arteries in iris and enlargement of pupil (Wall and Walker). *Usual cause*. Characteristics: (α) Inequality slight; often found only on shading. (β) Both pupils dilate on shading. (γ) Large pupil on side of smaller carotid pulse (if recognizable). (δ) No signs of affection of sympathetic nerve.

ii. Involvement by sac and *paralysis* of sympathetic nerve (dilator pupillæ); hence 3rd nerve unopposed. *Rare cause*. Characteristics: (α) Inequality marked. (β) Small pupil does not dilate on shading. (γ) Small pupil on side of smaller carotid pulse. (δ) Unilateral pallor, or flushing of face, sweating, and signs of sympathetic affection.

Note.—Irritation of nerve will cause dilatation, not contraction, of pupil, and phenomena will closely resemble (i).

iii. *Tabes* coexistent, with inequality of pupils. Rare.

d. **PRESSURE ON AIR TUBES AND LUNGS**.—

Lungs.—(i) On bronchi; produces: (α) Bronchitis; (β) Later, also dullness from collapse or retained secretion; (γ) Finally may be bronchiectasis, or suppuration. (ii) Large sac compressing lung substance: signs of collapse. Left bronchus mostly affected; hence physical signs at left base.

Tracheal Tugging.—Rare, except in aneurysms from transverse arch; due to pressure on bifurcation of trachea. Examine from behind, fingers under cricoid, head thrown back. Occasionally occurs in aortic incompetence, tumours.

Displacement of Trachea.—Less important. Draw line from point of thyroid cartilage to exact centre of notch.

Pressure on a Bronchus.—Suggestive of aneurysm: (i) Paroxysmal dyspnoea and cough; (ii) Physical signs at one base. Cough thus produced is not 'brassy'.

e. **PRESSURE ON RECURRENT LARYNGEAL NERVE**.—Most commonly left nerve, from anatomical relations; bilateral very rare. Results are: (i) Laryngoscopic: Affected

vocal cord nearer mid-line, abductor and, later, adductor paralysis. (ii) Alterations of voice: hoarseness, weakness; rarely complete aphonia. (iii) 'Bovine' cough.

Anatomy.—Recurrent laryngeal nerve supplies all muscles of larynx except cricothyroid (tensor of cords, supplied by superior laryngeal), viz.: (i) Abductors: posterior crico-arytenoids. (ii) Adductors: remaining muscles, internal thyro-arytenoid being also tensor of cords. During life, *tone* of abductors holds cords apart.

In lesions of recurrent laryngeal, abductors always affected more and earlier than adductors; lesions are unilateral (adductor paralyse generally bilateral and functional). Three stages occur (Semon):—

Stage 1.—*Abductor paralysis*: cord assumes more central 'cadaveric position'; further adduction on phonation. Usually producing no symptoms, but found on examination. Hence *important early sign*.

Stage 2.—*Paralytic contracture of unopposed adductor muscles*, drawing cord still nearer mid-line. Symptoms: dyspnœa on exertion, with some inspiratory stridor, from narrowing of glottis.

Stage 3.—*Adductor paralysis* follows. Results: (i) Earliest muscle usually internal thyro-arytenoid, loss of tensor action causing *alteration in voice*, hoarseness, weakness. (ii) Glottis cannot be closed: hence 'bovine' cough—viz., long wheeze without initial explosion. (iii) Dyspnœa increased. (iv) On examination: cord in mid-line, no movement on phonation.

VAGUS SPASM.—Rarely irritation of one vagus causes spasm of all glottic muscles, and approximation of cords by strong adductors. Hence asphyxia needing tracheotomy.

PHRENIC NERVE.—Never affected.

Symptoms.—(1) Pain. (2) Cough: (a) Simple; (b) Paroxysmal; (c) 'Brassy'; (d) 'Bovine'. (3) Dyspnœa. (4) Alterations in voice. (5) Hæmorrhage. (6) Dysphagia. (7) Rupture.

1. PAIN.—Most constant symptom; rarely absent, but very variable owing to the numerous causes; may be slight, continuous, severe, paroxysmal.

CAUSES.—

a. *Gradual dilatation of artery and stretching of nerve-endings*—'true aneurysmal pain'. Reflected over certain areas, with hyperæsthesia of skin. Nerves gradually atrophy, and hence this pain is *absent with large sacs*, and is most severe in early stages. Fairly continuous, but paroxysms also may occur: especially *nocturnal*.

b. Erosion of bones; irregular neuralgic pains.

c. Pressure on intercostal nerves; often paroxysmal.

d. Pressure on dorsal nerve roots after erosion of vertebræ; agonizing.

Saccular Aneurysm of the Aorta.—Symptoms, *continued*.

DISTRIBUTION OF PAIN.—When caused by:—

- a. Dilatation of artery.—*Reflected from arch of aorta over dorsal areas 1 to 4 and cervical 3, 4; also hyperæsthesia of skin.* Approximate distribution:—

Sinuses of Valsalva: Anginal pain; præcordium and left arm.

Ascending arch: On right side; from nipple to shoulder and neck, and to *back of head* (occipital headache), and sometimes inner side of right arm as low as wrist; may be frontal headache.

Transverse arch: Pain more on left than right; shoulder, back of head, left arm.

Descending arch and aorta: Below ductus Botalli referred to dorsal 5, 6, 7, viz., below left breast and left interscapular region; not in shoulder or arm.

- b. Erosion of bone.—Local pain.

- c. Pressure on intercostal nerves.—Pain *referred* to distribution of nerve; no hyperæsthesia of skin; from lower nerves radiates round *abdomen* as low as umbilicus.

- d. Pressure on dorsal nerve roots.—Pain *referred* to distribution round *abdomen*.

CONCLUSION.—In any case of obstinate or constantly recurring pain, to account for which no cause can be found, the possibility of aneurysm should be considered.

2. COUGH.—Very rarely absent.

CAUSES.—

- a. Pressure on trachea.—*Paroxysmal 'brassy' cough*; often characteristic.

- b. Pressure on bronchi.—Resulting in bronchitis, retention of secretion, and occasionally bronchiectasis; often *paroxysmal*.

- c. Pressure on large areas of lung.—Condition may simulate phthisis.

PECULIARITIES of cough frequent.—(a) 'Brassy'; (b) 'Bovine' or 'goose' cough (recurrent laryngeal nerve); (c) Paroxysmal.

3. DYSPNŒA.—Constant, on exertion, or paroxysmal.

CAUSES.—Pressure on:—

- a. Bronchus, especially left.—No stridor.

- b. Trachea.—Inspiratory stridor; often in paroxysms Especially in transverse arch. Frequently fatal.

- c. Recurrent laryngeal nerve.—Inspiratory stridor.

- d. Large areas of lung.

4. ALTERATIONS IN VOICE.—Hoarseness, weakness, rarely complete aphonia (*see* RECURRENT LARYNGEAL NERVE). May be earliest symptom.

5. HÆMORRHAGE.—

SMALL QUANTITIES.—From : (i) Exposed sac 'weeping' into trachea ; (ii) Granulations in trachea ; (iii) Destruction of lung alveoli. May continue for months.

LARGE QUANTITIES.—Rupture into air tubes or lungs. First bleeding often not fatal (owing to clotting), but life subsequently rarely exceeds few weeks. Rarely into œsophagus.

6. DYSPHAGIA.—*Uncommon*. Most often from descending aorta. (Bougie must not be passed.)

7. RUPTURE OF SAC.—Sites may be :—

EXTERNAL.—Rupture unusual even with large external tumour. Most to right of sternum. First external hæmorrhage rarely fatal owing to clotting.

TRACHEA AND BRONCHI.—Commonest site of rupture ; usually left bronchus ; sac erodes through.

PLEURA.—Especially descending aorta and arch. Occurs in about one-third of these. Rapidly fatal.

INTO LUNG SUBSTANCE.—Rarely rapidly fatal unless large air tubes opened.

Rare :—

ŒSOPHAGUS.

PERICARDIUM.—From sinuses of Valsalva, lower descending aorta, or lower ascending arch (may dissect downwards and then rupture). Sudden death.

SUPERIOR VENA CAVA (*see p. 854*). PULMONARY ARTERY, AURICLE.

Diagnosis.—Two essential data are : *Wassermann reaction* ; always positive in aneurysm, except rare arteriosclerotic group in elderly men. (2) *X-ray evidence*. Diagnosis from :—

MEDIASTINAL TUMOURS.—Often difficult. Note following points in tumours : (1) Sexes equal. (2) Rapid cachexia. (3) Rapid growth of tumour. (4) Secondary glands. (5) *Pulsation* not forcible ; very rarely expansile ; outline of tumour or dullness irregular. (6) No diastolic shock, no thrill (may be systolic murmur). (7) Pleurisy common. (8) Pressure effects less marked, *except on veins*. (9) Recurrent laryngeal nerve not involved ; phrenic may be (never in aneurysm). (10) Tracheal tugging very rare. (11) Irregular pyrexia common (aneurysm is apyrexial). (12) 'Red-currant jelly' sputum in primary lung growths ; otherwise scanty.

DYNAMIC PULSATION OF AORTA.—May be marked in : (1) Aortic incompetence. (2) Anæmia. (3) Exophthalmic goitre, neurasthenia, and neurotic conditions.

SCOLIOSIS AND DEFORMITIES, displacing heart and great vessels.—Difficulty rare.

PULSATING PLEURISY.—Nowadays very rare. Expansile impulse, but diffuse and not forcible. Pyrexia. Leucocytosis.

Terminations.—

1. CARDIAC FAILURE AND PULMONARY AFFECTIONS.—

Commonest cause, about 40 per cent.

2. RUPTURE OF SAC.—In less than one-third.

Saccular Aneurysm of the Aorta—Terminations, *continued*.

3. DYSPNOEA. — (Aneurysm is most frequent cause of extreme dyspnoea in adult males.)

4. EXHAUSTION, SEPSIS.

Prognosis.—

GENERAL PROGNOSIS.—Usually one to three years after recognition. Sudden death possible at any moment.

SITE.—Duration longest from high ascending arch. Short, from transverse arch.

EFFECT OF TREATMENT (mainly rest).—Relieves symptoms, and may cause reduction of sac—visibly in external tumours.

SPONTANEOUS CURE (by layers of fibrin).—Rare, but may prolong life five to ten years, or be discovered post mortem. Only in small sacculated aneurysms.

Treatment.—*Indications*: (1) Reduction in number and force of heart-beats; (2) Promotion of clotting in sac—all methods are unsatisfactory. Treatment is mainly *palliative*.

GENERAL PRINCIPLES:—

1. REST.—Absolute.

2. DIET.—Fluids *moderately* restricted; light or milk food diet.

3. BOWELS.—Regular action.

4. POTASSIUM IODIDE.—Gr. x, t.d.s. Relieves pain: action, probably on syphilitic mesoarteritis.

Result.—If maintained for weeks or months, pain and symptoms are ameliorated. An external sac is often visibly smaller. Improvement temporary.

TUFNELL'S TREATMENT.—(1) Rest. (2) Restricted fluid and protein diet: 8 oz. fluid and 10 oz. solid food: for several months. Too severe, and unsupported by results.

SYMPTOMATIC TREATMENT.—

EXTERNAL TUMOUR.—Ice-bag.

DYSPNOEA AND CYANOSIS.—Venesection. For urgent dyspnoea, tracheotomy, efficient in rare cases of bilateral abductor paralysis; if from pressure, rarely possible to get tube below obstruction.

COUGH.—Inhalations (tinct. benzoin. co.). Linctus heroin (gr. $\frac{1}{2}$ to $\frac{1}{12}$).

PAIN.—Ice-bag. Often needs morphia.

HIGH BLOOD-PRESSURE.—Nitrites. Venesection.

SYPHILITIC TREATMENT.—In young syphilitic patients, usual treatment. Salvarsan and similar preparations are not contra-indicated.

SPECIAL METHODS EMPLOYED TO INDUCE CLOTTING IN SAC (mentioned for completeness only).—

CALCIUM LACTATE.—Gr. xx daily for four days; omit one week and repeat. No evidence of action.

GELATIN.—Subcutaneous injection, 1 per cent solution, 10 oz. repeat every three to four days for 18 to 20 injections. *Negated* by difficulty of sterilization and frequency of *tetanus*.

INTRODUCTION OF WIRE INTO SAC, COMBINED WIRE AND ELECTROLYSIS, SCRATCHING SAC BY NEEDLE, and similar procedures, are dangerous.

ANEURYSM OF THE ABDOMINAL AORTA.

Site of Origin.—Usually close to diaphragm; coeliac axis often involved.

Direction of Extension.—From anterior wall forwards into epigastrium, towards the *left*. Occasionally backwards, eroding vertebræ.

Symptoms.—*Pain*, often intense; radiates round sides, or in back. There may be gastric symptoms. After erosion of vertebræ, compression myelitis.

Physical Signs.—

INSPECTION.—Epigastric pulsation (rarely projecting tumour).

PALPATION.—*Definite tumour with expansile pulsation* (only physical sign justifying diagnosis). Occasionally movable.

Often systolic murmur; may be audible at back. Sometimes thrill. Distal pulse usually small; may be absent.

Diagnosis.—Uncommon. Is frequently diagnosed erroneously. Distinction by (a) physical signs (*especially palpation*), (b) X rays, (c) Wassermann reaction, from:—

1. **PULSATING AORTA**—e.g., in anæmia, neurasthenia, and neurotic conditions.

2. **TUMOURS**—e.g., of pancreas—lifted by aortic pulsation. In these: (a) Pulsation not forcible; (b) Not expansile; (c) In knee-elbow position tumour loses pulsation.

Prognosis and Method of Termination.—Prognosis bad. Termination by:—

1. **RUPTURE.**—Usual termination. Into: (a) Pleura; (b) Peritoneum; less commonly—(c) Retroperitoneal tissues (simulating 'acute abdomen'); (d) Duodenum.

Occasionally:—

2. **EMBOLI** into superior mesenteric artery ('acute intestinal obstruction'); also other branches.

Rarely:—

3. **COMPLETE CLOT IN SAC.**

4. **PARAPLEGIA.**

Treatment.—*See THORACIC AORTA*, p. 852. *Compression* has been tried by hand, for repeated periods, under anæsthesia; some evidence of improvement; risk of damaging sac considerable.

Aneurysm of Branches of the Abdominal Aorta.—(1) Coeliac axis: often involved in aneurysm of aorta. (2) Superior mesenteric artery: emboli may cause 'infarction' ('acute intestinal obstruction'). Rarely: splenic artery, hepatic artery, renal artery.

ARTERIOVENOUS ANEURYSM.

Two Types.—(1) *Varicose aneurysm*: 'false' aneurysm between artery and vein. (2) *Aneurysmal varix*: direct communication.

Three Characteristic Signs.—(1) *Veins distended*. (2) *Intense thrill*: maximum at site, but propagated along vessels. (3) *Loud continuous murmur*, with systolic increase: similarly conducted often to a distance.

Varieties.—

1. **INTERNAL ARTERIOVENOUS ANEURYSM.**—From rupture of aortic aneurysms.

ASCENDING AORTA INTO SUPERIOR VENA CAVA.—Very rare.

Symptoms: (1) At moment of rupture, sudden pain, dyspnœa, and shock; (2) Murmur as above; followed by (3) Congestion and cyanosis of upper half of body in few hours.

ASCENDING AORTA INTO PULMONARY ARTERY.—More frequent. Symptoms as above: congestion less marked.

ABDOMINAL AORTA INTO INFERIOR VENA CAVA.—Very rare.

Symptoms as above: congestion of lower half of body.

2. **EXTERNAL ARTERIOVENOUS ANEURYSM.**—Peripheral vessels. From wounds. Signs as above: varicose veins and distension of limbs often extreme, occasionally absent.

CHAPTER CLV.**THROMBOSIS. EMBOLISM. PHLEBITIS. PERIARTERITIS NODOSA.****Definitions.**—

THROMBOSIS.—The formation of a solid mass or plug in the living heart or vessel from constituents of the blood (Welch).

EMBOLISM.—The obstruction of a vessel by the impaction in its lumen of a clot or foreign matter carried to it by the circulation.

PHLEBITIS.—Pathological changes in the internal and other coats of a vein.

INFARCT.—Changes in tissues of which the customary blood-supply has been obstructed.

Mode of occurrence of thrombosis and embolism is of great complexity and much disputed. Factors are probably numerous, and vary in different conditions. This chapter does not refer to: (a) Cardiac thrombi and resulting embolism; (b) Thrombosis secondary to gross sepsis (suppuration); (c) Emboli of fat or parasites; (d) Coronary thrombosis (*see* p. 834). Thrombosis and phlebitis will be considered together, as thrombo-phlebitis: *the chapter deals with the occurrence of non-suppurative thrombo-phlebitis and resulting embolism.*

NOTE.—Thrombosis in varicose veins injected for treatment practically never results in pulmonary thrombosis: fact attributable to blood flowing distally and clot produced extending in same direction.

Etiology.—**VARIETIES IN RELATION TO CAUSE.—**

1. Idiopathic recurrent thrombo-phlebitis. Thrombo-phlebitis migrans.
2. Simple (traumatic) thrombo-phlebitis.
3. Post-operative pulmonary embolism; and associated post-operative lesions.
4. Occurring as sequel to typhoid fever, influenza, and other debilitating conditions.
5. Puerperal thrombosis: phlegmasia alba dolens.
6. Gout.

SITE OF THROMBO-PHLEBITIS.—May occur in any site, but most common in left lower extremity.

GENERAL FACTORS INFLUENCING THROMBOSIS.—

1. **ALTERED CONDITIONS OF THE BLOOD.**—Coagulability increased in certain anæmias, increased platelets, altered concentration of blood, etc.
2. **DISTURBANCES OF THE CIRCULATION.**—Slowing of the current (stasis): low blood-pressure. Stasis of itself does not lead to thrombosis if other factors are normal. Note: (a) Recumbency—e.g., rest cures—does not produce thrombosis; (b) In typhoid, thrombosis is more common in convalescent period.
3. **LESIONS OF THE VESSEL WALL.**

Idiopathic Recurrent Thrombo-phlebitis.—**CHARACTERISTICS.—**

1. Hereditary factor marked.
2. Both sexes affected. Usually commences at middle age.
3. No vascular disease. Blood-pressure low.
4. Superficial vessels of lower limb most commonly attacked, but not confined to these: may be multiple.
5. Recurs without obvious cause: often over many years.
6. 'Pulmonary embolism' not uncommon termination. Recovery may follow one or even more attacks.

NOTE.—Some instances recorded as 'pulmonary embolism' are believed (especially by French authorities) to be *thrombosis of pulmonary artery or of pulmonary vein*. Sudden death also occurs from cerebral embolism and cerebral thrombosis.

Condition is definite proof of an hereditary 'thrombotic diathesis'.

Simple (Traumatic) Thrombo-phlebitis.—Thrombosis usually of lower extremity. May follow trauma, but often no recognizable cause: blood-pressure generally low, and arteries not thickened. Great tendency to recurrence even in simplest forms. Common condition.

Post-operative Pulmonary Embolism, and associated lesions.—

Not uncommon. Fatal occurrence: 1 in 1000 operations. Lesser grades at least 10 times as frequent. Relation to post-operative massive collapse of lungs and pneumonia uncertain. Causation much disputed. Note: (1) Higher incidence after certain operations, e.g., on pelvic viscera and gall-bladder. May occur

Post-operative Pulmonary Embolism, continued.

after minor operations, e.g., simple laparotomy, hernia. (2) Post-operative thrombosis does not always occur in vicinity of wound, e.g., thrombosis of left leg occurs with operation on right side. Factors, and questions in dispute, include:—

1. **SEPSIS.**—Against influence: (a) Majority of instances occur with no evidence of sepsis—though case-incidence is higher with suppuration; (b) No obvious origin of clot in region of wound (generally but not universally agreed). In favour: (a) Influence of suppuration so definite—e.g., lateral sinus thrombosis—that a *mild* sepsis may be supposed; (b) Clots traced to wound (very rare).
2. **STASIS.**—Attributed to immobility after operations and to debilitating conditions (*see* ETIOLOGY). Accepted as contributory factor: early exercise after operations of doubtful benefit.
3. **INJURY TO VESSELS DURING OPERATION.**—Attributed to: (a) Direct injury, e.g., large uterine veins; (b) Strained positions during operation. Note: Embolism is rare after operations involving large veins in neck.
4. **BLOOD-PLATELETS.**—Number rises after operations, or labour, reaching maximum about tenth day (when embolism is commonest): similar rise during convalescence after prolonged fevers (Howel Evans).
5. **PRIMARY PULMONARY THROMBOSIS,** and question: site of formation of clot.—Suggested that apparent pulmonary embolism is often thrombosis, on following grounds: (a) Original site of a clot is rarely found; (b) Gall-bladder and some other common operative sites drain into portal and not systemic circulation; (c) Cerebral emboli cause some post-operative deaths—origin suggested from pulmonary veins; (d) Thrombi stated to be found in pulmonary arteries.

NOTE.—Similar view suggested for idiopathic recurrent thrombo-phlebitis. If correct, factors of sepsis and injury are negligible. Some cases are certainly emboli. With regard to cerebral emboli, other theories are: (a) They pass through foramen ovale from right heart—i.e., paradoxical emboli (occurrence rare); (b) They form in diseased hearts—improbable.

In discussions on this subject, little attention has been paid to pre-operative, constitutional, and hereditary factors.

Sequel to Typhoid Fever.—*See* p. 10.

Gout.—Thrombo-phlebitis may occur in course of acute gout. Many independent cases formerly erroneously attributed to gout.

FEMORAL VEIN THROMBOSIS.

Symptoms.—Symptoms of thrombosis are illustrated by occurrence in veins of lower extremity, especially femoral and saphena veins. Symptoms depend on (a) formation of thrombus, (b) effect on blood-supply.

ONSET.—Chilly sensations or definite rigor. Temperature 99° to 101° or 102° F. May precede local symptoms.

PAIN.—In affected vessels. In femoral thrombosis, commences in calf. Onset rapid or sudden. Degree varies: may be severe.

THROMBOSED VESSEL TENDER.—If superficial, it may be palpable as firm cord. May be red line on skin.

ŒDEMA.—Commences usually in calf: spreads up or down. Often very tense. Pitting slight.

Extremity may be pale and cold, or red and hot.

Symptoms may be very slight when occurring in course of illness, and in debilitated subjects.

Course.—Acute symptoms usually subside after a week. May extend to iliac vein: or to inferior vena cava (both legs become swollen and œdematous).

Sequelæ.—

1. **EMBOLISM.**

2. **RECURRENCE.**—Often occurs even with prolonged rest: especially in 'traumatic' and 'idiopathic' forms. No period appears sufficient to prevent it: advisable to warn relations. Watch for rise of temperature and rigors.

3. **LOCAL EFFECTS.**—May persist for months or years: heaviness, œdema after exertion; impaired circulation; muscles may atrophy. Pain may be severe, or sciatica. Gangrene: only if arteries also involved.

Treatment.—

REST.—Complete for at least four and preferably six weeks (for prevention of embolism). Limb elevated, slightly flexed at knee, on inclined plane, wrapped in cotton-wool; preferably immobilized with splint, alternatively by sandbags. Belladonna ointment may be applied.

PAIN.—Morphia for few days, if severe

DIET.—Ordinary but light diet.

DRUGS.—Useless. Withholding calcium and administering citrates useless but harmless.

ACTIVE TREATMENT.—None until: (1) Six weeks; (2) Temperature normal four weeks; (3) No tenderness; (4) Œdema diminishing. Commence superficial rubbing, progress to massage. No electrical treatment

SPA.—Bagnolles de l'Orne specializes in after-treatment.

THROMBO-ANGITIS OBLITERANS.

(*Buerger's Disease.*)

An inflammatory hypertrophy of the coats of arteries and veins, followed by thrombosis resulting in partial or complete obstruction of the circulation.

Etiology.—Mainly in male Hebrews over 40 years. Tobacco is most important factor. Syphilis doubtful.

Site.—Especially in lower extremities, but no vessel immune.

Thrombo-Angiitis Obliterans, continued.

Symptoms.—(1) Pain in calf and intermittent claudication—earliest symptoms; (2) Gangrene; (3) Vasomotor changes—pallor or redness—gradually develop, especially when limb dependent. May be painful thickened areas along vessels. Progresses with intermissions.

Physical Signs.—Affected vessels may be palpable. Pulsation in arteries of feet diminished or absent. Collateral circulation may develop.

Treatment.—Rest and elevation. No tobacco. Amputation may be necessary. Periarterial sympathectomy unsuccessful. Presacral neurectomy under trial.

PHLEBITIS MIGRANS.

Multiple spindle-shaped swellings developing along course of veins. Usually upper extremity, especially at elbow.

Swelling firm: moderately tender: about one inch in length: no thrombosis: circulation not obstructed: little or no œdema. Tend to wander along the vessels.

Etiology unknown. May be syphilitic, but not always.

Note.—Has no connection with thrombo-phlebitis migrans.

PERIARTERITIS NODOSA.

An inflammatory lesion of smaller arteries, commencing in adventitia, and resulting in nodules and in secondary aneurysm.

Etiology.—Mainly middle-aged males. Any nationality. No predisposing factors. Syphilis rare. No intestinal parasites recorded.

Morbid Anatomy.—Probably specific infection. Onset in adventitia, small-round-cell infiltration, extending towards intima. Results in multiple secondary aneurysms (up to size of walnut), which rupture, forming hæmatomata, or thrombose and canalize.

SITES.—Mesenteric, renal, and hepatic arteries most affected.

Symptoms.—Onset with weakness and pains in limbs; pyrexia. Painful nodules may be palpable. Epigastric pain, vomiting, and diarrhœa. Loss of flesh. Polynuclear leucocytosis.

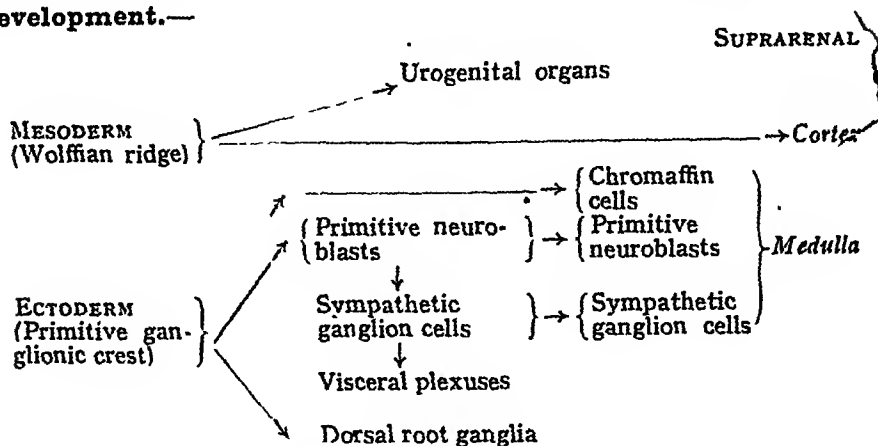
Duration.—Few weeks to months. May recover.

Diagnosis.—From trichiniasis, miliary tuberculosis, typhoid.

Treatment.—Symptomatic.

Histology and Functions of the Suprarenal Bodies, *continued*.

Development.—



Functions of the Cortex.—Is essential to life. Concerned with :—

1. *Sexual activity*. Regulates especially secondary sexual characters.
2. Various vaguely known functions—e.g. : (a) Control of sodium metabolism. In absence, increased excretion of Na, and with it of Cl; corresponding falls in these substances in blood-serum, and dehydration follows; K rises in serum, possibly from concentration (K possibly has toxic action on muscular tissue). (b) Constant control of blood-pressure (deficiency exhibited in Addison's disease, excess in certain tumours), formerly erroneously ascribed to medulla. (c) Stores vitamin C; relation to other functions uncertain, but presence of vitamin C known to inhibit pigmentation. *Note*.—Lactoflavine (see vitamin B₂) is inactive in absence of adrenal cortex. (d) May have some control over metabolism of carbohydrate, fat, and cholesterol.

CORTICAL HORMONES.—Nature uncertain : multiple. Corticosterone is a crystalline substance recently isolated and highly potent; has steroid structure and cyclo-pentone-phenanthrene nucleus (like sex hormones).

OVER-ACTIVITY.—Produces over-development of male characters (virilism) in both sexes. Type of virilism varies with time of onset of over-activity (and with sex); occurring early it influences structure and some forms of growth, later mainly affects functions. In cases of virilism, cortical cells stain with fuchsin, as also cells in anterior pituitary and interstitial cells of testis.

FEMALES.—Onset in :—

1. *Fœtal Life*.—Result : Pseudo-hermaphroditism.
2. *Early Childhood*.—Precocious sexual development, such as premature menstruation.
3. *After Puberty*.—Virilism (amenorrhœa, hirsutism, male voice).

MALES.—Onset in :—

1. *Fœtal Life.*—Result uncertain.

2. *Early Childhood.*—Great muscular development ('infant Hercules'). Mental precocity and abilities may be extreme ('infant prodigies'); bodily growth may also be rapid. Precocious male development.

3. *After Puberty.*—Over-development of male characters.

Note.—Manifestations in certain types indistinguishable from Cushing's syndrome (see TUMOURS OF THE SUPRARENAL GLANDS, p. 864 and BASOPHIL ADENOMA OF THE PITUITARY, p. 906).

UNDER-ACTIVITY.—In Addison's disease.

Functions of the Medulla.—

An active principle has been isolated and prepared synthetically, known as 'adrenalin' or 'epinephrin'; all chromaffin tissue contains adrenalin.

Medulla is not essential to life. Is connected with and can control (temporarily) sympathetic nervous system; other functions doubtful; possibly connected with thyroid and heart regulation

ACTIVE MEDULLARY SECRETION (i.e., adrenalin into blood).—

Now believed to be an emergency mechanism for occasions of crisis. Action is sudden and very rapid, but paroxysmal and transitory. Effects are those of sympathetic stimulation—e.g., dilated pupils, erection of hairs, rapid pulse, rise of blood-pressure; also rise of blood-sugar, constriction of vessels of skin and splanchnic area, relaxation of muscles of intestines and bronchioles.

Amount is diminished in certain acute diseases, e.g., diphtheria.

MAIN ACTION OF ADRENALIN INJECTIONS.—(1) *Constrict peripheral blood-vessels*; coronary arteries dilate; pulse slow and later increases. (2) *Raise blood-pressure*. (3) *Hyperglycæmia*: from increased glycogenolysis in liver. *Note*: Adrenalin is antagonistic to pancreas (insulin) and also to pituitary. Inert by mouth.

(See also PIGMENTATION OF THE SKIN, p. 863).

II. ADDISON'S DISEASE.

A rare condition characterized by progressive weakness, low blood-pressure, and gastro-intestinal disturbances, and by pigmentation of the skin, resulting from disease of the suprarenal bodies.

Etiology.—

AGE.—Wide limits: commonest between 20 and 40 years.

SEX.—Males in some excess.

No relation to heredity, race, or other disease except tuberculosis.

Pathogenesis.—Now ascribed to disease of cortex, and not, as previously, to medulla. (See FUNCTIONS OF THE CORTEX, p. 860, and PIGMENTATION OF THE SKIN, p. 863.)

Carbohydrate Metabolism.—Hypoglycæmia usual, due to absence of adrenalin action on liver: probable cause of asthenia. Ketosis also develops in later stages, resulting in convulsions, coma, etc.

Addison's Disease, *continued*.

Morbid Anatomy.—(Cortex is always destroyed: medulla may escape.)

LESIONS OF THE SUPRARENAL BODIES.—

1. **TUBERCULOSIS.**—In great majority: other causes very rare. Usually advanced caseation, bilateral, and secondary to tuberculosis elsewhere, e.g., lungs.

2. **ATROPHY.**—Simple, or with chronic fibrosis.

3. **MALIGNANT DISEASE**, hæmorrhages, hydatid disease, etc.

CHROMAFFIN TISSUE IN PARAGANGLIA is usually involved with the suprarenals. Exceptions rare: may account for disease of suprarenals without Addison's symptoms. Also very rarely the converse—viz., suprarenals normal, paraganglia affected by pressure or inflammation, and symptoms present.

THYMUS.—Often enlarged.

OTHER ORGANS.—Changes slight. Heart in brown atrophy. May be tuberculosis elsewhere.

Symptoms.—

ONSET.—Insidious; rarely acute. Initial symptom is usually *weakness*, muscular and general. Often months before symptoms become characteristic.

CHARACTERISTIC SYMPTOMS.—

1. **ASTHENIA.**—Extreme and progressive, muscular and cardiovascular—*see* (4)—disproportionate to wasting.

2. **GASTRO-INTESTINAL DISTURBANCES.**—Variable; may be absent until late stage; remissions common. *Anorexia* marked. Nausea. Attacks of obstinate *vomiting*. Constipation early; later may be diarrhœa.

3. **PIGMENTATION OF SKIN.**—*Colour*: Light brown to deep brown or almost black. *Distribution*: On parts: (a) Exposed; (b) Normally pigmented; (c) Exposed to irritation, e.g., waistband; (d) Mucous membranes—here usually patchy. No itching. Occasionally: deeply-pigmented spots; leukoderma. Pigmentation rarely absent.

4. **LOW BLOOD-PRESSURE AND CARDIAC WEAKNESS.**—*Systolic blood-pressure* 70 to 90 mm. Hg. Pulse feeble. Giddiness and syncope common.

OTHER SYMPTOMS.—*Wasting*, but not extreme emaciation. *Anæmia* rarely marked, may be relative lymphocytosis; abnormal megaloblastic anæmia occasionally present. *Temperature* often subnormal. Headache and pain in the back; occasionally neuralgias. 'White line' after scratching skin: often definite, but value slight. *Urine*: no chronic changes. *Blood-sugar*: usually diminished.

MINERAL METABOLISM.—Excretion of Na and Cl increased and K falls. Reverse changes in blood. Amount in serum in mgm. per 100 c.c.—

	Normal	Addison's Disease
Na	325-350	275
Cl	350-375	250
K	20	30

'CRISES.'—Exacerbations in course of few days of asthenia, vomiting (may be extreme), loss of weight, fall of blood-pressure (e.g., to 70 mm. systolic), low temperature, psychical disturbance. Condition of shock attributed to loss of sodium causing dehydration, with which following manifestations are associated: (1) Rise of blood-urea; (2) Rise of plasma protein, red cells, hæmoglobin, viscosity of blood; (3) Hypoglycæmia.

Course.—General advance, with remissions and crises. Death may occur in crises, from weakness, cardiac failure, coma, convulsions. May be tuberculosis.

DURATION.—Usually one to three years. Rarely, a few months; or up to ten or more years.

RECOVERY recorded in a few apparently authenticated cases.

Diagnosis.—Based on characteristic symptoms, *asthenic group* being essential. Note absence of cause, and of other factors producing pigmentation. Mucous membranes escape pigmentation in other conditions, except rarely in forms due to intra-abdominal disease. *Radiographs*: may show calcified suprarenals. *Neurasthenia* may simulate the disease closely, especially with pigmentation of a multipara. Dark-skinned races difficult. Pernicious anæmia may rarely simulate the pigmentation. Also diagnosis from: carcinoma of stomach, Simmonds' disease.

Treatment.—Main manifestations now ascribed to loss of sodium.

TREATMENT TO REMEDY SODIUM LOSS.—

1. **SUBSTITUTION THERAPY WITH CORTICAL EXTRACT.**—To check loss of sodium. Eucortene in use for several years (very expensive). Dosage empiric. Initially: intravenous injection 10 to 50 c.c. daily. Maintenance dose: may be few c.c. daily, intramuscular. Improvement in muscular strength often marked, especially in crises; less effect in stationary periods; little change in blood-pressure and pigmentation.

2. **SODIUM THERAPY.**—To replace loss. Dosage: about 12 gm. daily; give chloride, bicarbonate, and citrate in equal amount. Improvement may be rapid in crises, but value mainly to reduce dose of cortical extract required.

Potassium should be reduced in diet, i.e., omit potatoes and vegetables (give necessary vitamins).

SYMPTOMATIC TREATMENT.—Rest and warmth.

CRISES.—Intravenous injection: 600 c.c. of NaCl, 5 per cent, with glucose.

PIGMENTATION OF THE SKIN.

In dark races, Addison's disease, and melanotic growths, pigmentation is due to melanin. Note: (1) Melanin is formed by oxidation of a colourless precursor, melanogen, some of which is present in ordinary skin; (2) Melanogen is produced from tyrosine and is closely akin to adrenalin (and to hæmoglobin); (3) In Addison's disease, suprarenals fail to convert tyrosine into adrenalin, excess collects in cells of skin

Pigmentation of the Skin, continued.

as melanogen, and is oxidized to melanin. Deficiency of vitamin C may also be a factor. Formation also increased in certain metabolic disturbances, e.g., hyperthyroidism, liver diseases, pregnancy, tuberculosis treated with light.

Common Causes of Diffuse Pigmentation.—

1. CHRONIC IRRITATION OF SKIN.—'Vagabond's discoloration.' From lice and dirt. Many scratches.
2. INTRA-ABDOMINAL CONDITIONS.—(a) Tuberculosis; Addison's disease. (b) Cancer; especially of *peritoneum* (frequently).
3. ARSENIC.
4. PREGNANCY.—Especially affects face: transient. Occasionally in uterine disease.
5. SKIN CONDITIONS, e.g., leucodermia.

Rarer Causes.—Exophthalmic goitre. Malaria. Lymphadenoma. Atypical leukæmias (colour varies).

Various, Rare, or More Localized Conditions.—Hæmochromatosis. Melanotic neoplasms. Argyria. Pellagra: localized. Ochronosis. Von Recklinghausen's disease.

Conditions which may give rise to Difficulties in Diagnosis.—Neurasthenia. Chronic constipation. Chronic mild jaundice, e.g., pernicious anæmia; also pseudo-jaundice (*see* DIABETES MELLITUS, p. 339). Chronic cardiac and renal conditions.

III. TUMOURS OF THE SUPRARENAL GLANDS.**Tumours of the Cortex.—**

ENLARGEMENTS OF CORTEX.—Associated with manifestations of *over-activity* (*see* FUNCTIONS OF CORTEX, p. 860). In order of frequency:—

1. Simple hypertrophy.
2. Benign adenoma.
3. Hypernephroma of cortex. Malignant.
4. Carcinoma of cortex. Malignant.

All produce same syndrome. Are of yellow colour characteristic of normal adrenal cortex. Liable to hæmorrhage and thrombosis causing ACUTE ADRENAL INSUFFICIENCY (*see* p. 865).

SIMPLE HYPERTROPHY.—May be operable. May occur with tumours of pituitary (basophil adenoma) and true neoplasms of thymus.

TUMOURS RESEMBLING ADRENAL CORTEX (not associated with over-activity).—

1. Renal hypernephroma: Grawitz's tumour.
2. Ovarian hypernephroma.
3. Lutein tumours.

Tumours of the Medulla.—Develop from the three types of cell in the medulla (*see* DEVELOPMENT, p. 860).

1. **NEUROBLASTOMA**.—From primitive neuroblasts. Almost confined to children. Formerly known as 'retroperitoneal sarcoma'. Consists of round cells, arranged in 'rosettes' (actually at periphery of spheres) as in foetal medulla. No manifestations of abnormal suprarenal activity. Malignant.

METASTASIS.—Distribution different on the two sides:—

- a. *Right Side*.—'Pepper's syndrome'. In mesenteric glands, liver, lungs.
 - b. *Left Side*.—'Hutchinson's syndrome.' In skull (often first sign of disease): *exophthalmos*, signs of cerebral tumour.
2. **GANGLIONEUROMA** - From sympathetic ganglion cells. Occurs at any age. Usually innocent. Consists of nerve-cells and non-medullated nerve-fibres. Also arises in abdominal sympathetic system, and rarely in central nervous system.
 3. **CHROMAFFIN TUMOUR** (*Phaeochromocytoma*).—From chromaffin cells. Patient usually over age of 40. Innocent. May arise from chromaffin tissue at any site (see p. 859): arising outside suprarenal is also known as 'paraganglioma'.

Has structure of suprarenal medulla. Produces internal secretion (adrenalin).

SYMPTOMS.—(1) High blood-pressure and symptoms of hypertension (without renal lesion). Hypertension often paroxysmal. Cure may follow removal of tumour. (2) Cerebral hæmorrhage. Neurofibromatosis may occur.

Hypoplasia and Hyperplasia of Suprarenal Glands.—Absence occurs in monsters, especially with skull defects. Hypoplasia is described in *osteogenesis imperfecta* and *osteomalacia*. Hyperplasia of cortex occurs in chronic nephritis.

IV. ACUTE ADRENAL INSUFFICIENCY.

Rapid or even sudden death may occur from acute adrenal insufficiency, e.g., hæmorrhage or thrombosis of suprarenal; may be previous symptomless tumour or disease.

Symptoms may be abdominal pain and acute abdominal symptoms and collapse; sometimes resembles cerebral hæmorrhage.

CHAPTER CLVII.

DISEASES OF THE THYMUS GLAND.

I. FUNCTIONS OF THE THYMUS GLAND.

Thymus at birth weighs about 15 to 20 gm. Maximum, at 12 years, about 30 gm. Atrophy then commences. Occasional weights up to 50 to 70 gm.

Functions unknown. Results doubtful after extirpation; may be none, or cachectic conditions; may be hypertrophy of testis. Evidence of internal secretion slight, but suprarenal hypertrophy is recorded with thymic neoplasm. Injection of thymus extract continued through successive generations of rats said to produce sexual precocity and increased growth (unconfirmed).

II. ENLARGEMENT OF THYMUS.

Occurrence.—

1. **HYPERPLASIA.**—Occasionally in: (a) Graves' disease; (b) Addison's disease; (c) Myasthenia gravis; (d) Acromegaly; (e) Castration.
2. **TUMOURS.**—Rare. Innocent or malignant—carcinoma, sarcoma, lymphadenoma. Symptoms of mediastinal tumour. Treat by X rays.
3. **AFFECTIONS OF LYMPHOID TISSUE.**—Acute infections, leukæmia, etc.

Status Lymphaticus.—Traditionally described as a condition, occurring in flabby children, characterized by enlargement of the thymus and lymphoid tissue, and usually recognized at autopsy following sudden death from trivial causes. Recent investigations uphold: (1) No evidence of enlarged thymus in anæsthetic and sudden deaths; (2) No general lymphoid hyperplasia in cases of abnormally large thymus. Evidence is thus against existence of status lymphaticus as a cause of unexpected death.

CHAPTER CLVIII.

DISEASES OF THE PINEAL BODY.

Pineal body develops as outgrowth from roof of diencephalon. In adult life, consists mainly of ependymal cells with neuroglia and connective tissue: no evidence of glandular tissue. Contains calcareous concretions. In certain animals, consists of more highly differentiated tissue, and appears sensitive to light; ancient theory held it to be a 'third eye'.

Hormone Production.—Uncertain. Pinealectomy: usually no results. Injection of extracts in successive generations of rats: increasing sexual precocity and dwarfism: unconfirmed.

Symptoms attributed to Tumours.—

1. Macrogenitosomia; testes enlarged. Overgrowth and obesity, but at 6 years epiphyses unite (pubertas præcox).
2. Signs of cerebral tumour: loss of pupillary reaction to light; restriction of upper movement of eyeball.

RADIOGRAPHS.—Shadow of calcareous deposits in glands. Dilated ventricles (ventriculogram).

Treatment.—Deep X-ray therapy.

CHAPTER CLIX.

DISEASES OF THE THYROID GLAND.

I. MORPHOLOGY AND FUNCTIONS OF THE THYROID GLAND.

The thyroid gland consists essentially of a number of vesicles or follicles varying greatly in size, supported by connective tissue containing blood-vessels, lymphatics, etc. The vesicles are lined by a single layer of low cuboidal epithelium, and contain 'colloid'. The thyroid is rich in iodine, containing normally 0.1 to 0.5 per cent of its dried weight. There is no true lobulation, all portions of parenchyma being connected as are the nuclei of polymorphonuclear leucocytes. There is no excretory duct.

Thyroid Secretion.—The epithelial cells form an active secretion which is present in the colloid, and is absorbed direct into the circulation.

THYROXIN.—Isolated by Kendall in 1915. Reproduces effects of thyroid administration, but only on injection; is also insoluble; is thus not identical with thyroid secretion. Contains 65 per cent iodine. Synthesized by Harrington, 1927: proved to be tetra-iodo-oxyphenyltyrosine: found to exist in optically active dextro- and laevorotatory forms; latter most active. Active principle of thyroid is probably an 'optically active thyroxin polypeptide'.

FUNCTIONS.—Controls processes of oxidation; thus regulates metabolism and heat production. Has effect on calcium metabolism, possibly through the parathyroid (*see* p. 895). Is probably necessary for correct formation of blood.

Has interrelations with the anterior pituitary.

Gudernatsch's Test for Thyroid Activity.—Active thyroid, fed to young tadpoles, accelerates metamorphosis, resulting in dwarf frogs. (Thymus has opposite effect.)

Supply of Iodine.—Normal daily need about 0.16 mgm. Is obtained from: (1) *Food*—main supply; (2) *Water*.

MOUNTAINOUS SOIL is poor in iodine owing to: (1) Washing by heavy rain and snow; (2) Lack of atmospheric iodine, this being influenced by (a) distance from sea, and (b) altitude.

II. THYROIDITIS.

Inflammation, simple or acute suppurative. Both very rare, especially latter. Secondary to sepsis elsewhere or acute infectious disease. *Symptoms*: Acute local and constitutional signs of sepsis.

III. TUMOURS OF THE THYROID.

Benign: Adenoma.

VARIETIES. — (1) Parenchymatous; (2) Colloid; (3) Fœtal adenoma.

PARENCHYMATOUS AND COLLOID TYPES. — May be multiple or single. *Multiple form*: Identical with nodules of 'nodular goitre', and is a synonym for the latter. *Single form*: Remainder of gland normal; definite fibrous-tissue capsule; hyaline and other degenerations occur in centre (from poor blood-supply); otherwise as in a nodule of nodular goitre. *Clinically*: May be toxic or non-toxic (presence or absence of hyperthyroidism), without distinguishing features on examination or pathologically; especially single form.

FŒTAL ADENOMA. — Single. Composed of colloid-free vesicles; epithelium resembles fœtal gland; definite capsule. Disputed whether a 'true benign neoplasm' or reaction of gland to a stimulus. Stated never to cause hyperthyroidism; when associated with it, remainder of gland is hyperplastic and adenoma is a disconnected incident.

SPECIAL SYMPTOMS. — Single adenoma commonest in lower pole or isthmus: hence may extend into thorax, causing pressure effects (see SUBSTERNAL GOITRES, p. 872).

Malignant. —

VARIETIES. — Three principal forms: (1) Malignant adenoma (2) Papilliferous adenocarcinoma; (3) Carcinoma simplex.

MALIGNANT ADENOMA (Adenocarcinoma). — Commonest in, but not confined to, pre-existing goitres and goitrous districts. Course rapid or chronic. Encapsuled. Tissue has general resemblance to normal or hyperplastic thyroid, sometimes closely. May produce hyperthyroidism. No tendency to penetrate capsule or involve glands of neck. Metastases common. In the 'metastasizing struma of Langhans' the primary growth is small, with almost normal structure, and is often only discovered after large metastases or at autopsy.

PAPILLIFEROUS ADENOCARCINOMA. — No relation to previous goitre. Occurs later than malignant adenoma. Slow growth: may be many years. Toxicity very rare. Tends to penetrate capsule, and to involve skin and glands near; but not to produce distant metastases. May involve accessory thyroid in neck and thorax. On section, papilliferous growths are seen: may be cystic areas.

CARCINOMA SIMPLEX (Spheroidal-celled). — No relation to previous goitre. Growth rapid or slow. Never toxic. Tends to penetrate capsule and involve lymphatic glands: also forms distant metastases. Tumour usually hard, and pressure effects early.

INTERMEDIATE FORMS between carcinoma and adenocarcinoma common.

RARE. — Sarcoma. Teratoma. Secondary growths, e.g., from œsophagus.

SYMPTOMS.—Growth surrounds vessels and structures, while goitres displace them: hence *early fixation*, and marked pressure symptoms—dysphagia, dyspnoea, cough, hoarseness, congestion and œdema of face, inequality of pupils, etc. Perforation into trachea or œsophagus not common. In certain types, may be adhesion to skin, enlargement of lymphatic glands. Myxœdema or hyperthyroidism has occurred.

METASTASES.—

SITES.—(a) Bones: usually skull, jaw, long bones, sternum, pelvis. (b) Lungs. Occasionally liver and kidneys.

Histologically, all degrees, from almost normal thyroid tissue to carcinoma not suggesting thyroid. May pulsate.

DIAGNOSIS.—Malignancy suggested by: (1) Rapid growth; (2) Hardness; (3) Fixation to trachea. May be clinically indistinguishable from simple adenoma; also from Riedel's disease.

Tumours of Aberrant Thyroids.—Lingual thyroid: *Central swelling at back of tongue*; not uncommon; from remains of thyroglossal duct; cysts and hæmorrhages common; interferes with swallowing; removable by operation; thyroid gland may be absent, and myxœdema follow. Rarely in other sites. Tetany never follows removal of a lingual thyroid, owing to position of parathyroids.

Tuberculosis, Syphilis, etc.—Very rare.

IV. SIMPLE GOITRE.

A chronic general or irregular enlargement of the thyroid gland, occurring endemically or sporadically, producing symptoms by pressure, but without gross disturbance of thyroid function.

SYNONYMS.—Diffuse parenchymatous goitre. Diffuse colloid goitre. Endemic or sporadic goitre. Nodular goitre (non-toxic). Adenoma of goitre (certain forms only).

Pathogenesis.—Two principal groups:—

1. **ENDEMIC.**—Due solely to iodine deficiency. Foci in mountainous districts, especially remote from sea. Heredity becomes a factor in centres: goitrous parents have goitrous, cretin, or cretinoid children. Foci in Switzerland and central mountainous Europe; Himalayas; Central Asia; Japan; Belgian Congo; northern states of United States; Britain, in Derbyshire; New Zealand, close to sea (soil iodine-poor).

ETIOLOGY.—Sexes equal. Onset commonest about 7 to 10 years: often visible earlier.

2. **SPORADIC.**—Cases occur in all parts: food contains adequate iodine. Cause uncertain, but possibly unabsorbable iodine, or factors producing relative iodine deficiency in thyroid, e.g.: (a) *Polluted waters, rich in bacteria*: Possibly by interference with assimilation (see also SOUTH AMERICAN TRYPANOSOMIASIS, p. 192). (b) *Faulty diets*: (i) Certain vitamin deficiencies (unelucidated); (ii) Excessive fat and protein. *Note*: Most fat contains oleic acid, which is unsaturated and combines with iodine; cod-liver oil contains 0·002 per cent iodine.

ETIOLOGY.—Sex: females 6 or more to 1 male. Onset commonest at 14 to 16 years.

Simple Goitre—Pathogenesis, *continued*.

GOITRE SPRINGS.—Famed for rapid production of goitre in endemic areas: probably combined pollution and iodine-deficiency.

PUBERTY GOITRES.—Usually of little importance. *Treat with iodine.*

Thyroid may also enlarge in pregnancy and at menopause; and temporarily during menstruation and coitus.

Pathology.—Pathological changes in sporadic and endemic groups are similar in type.

EXPERIMENTS IN ANIMALS.—Animal experiments recently have indicated mode of development of various forms of simple goitre: evidence points to simple goitre in man having similar sequence.

STAGE 1: REMOVAL OF PORTION OF THYROID.—(Equivalent to occurrence of iodine-deficiency or the sporadic stimuli in man).

Result.—(i) Increase in blood-supply, vessels dilate; (ii)

Hyperplasia—i.e., proliferation of cells altering in type to cubical or high columnar, may be folding ('plication') of epithelium into the acini. Connective tissue increases.

Condition is 'parenchymatous goitre'.

STAGE 2: ADMINISTRATION OF IODINE.—Produces compensation. (Equivalent to cessation or compensation of stimulus in man.)

Result—(i) *Involution*—hyperplasia and vascular dilatation subsides; (ii) *Colloid* increases and distends acini and further flattens epithelium by pressure.

Condition is 'colloid goitre'.

Note.—Cessation or compensation of stimulus results in *colloid or resting stage*, and not return to normal thyroid.

'Colloid goitre' is always a sequel of previous hyperplasia.

NOTE.—Above changes are usually not uniform throughout gland. Portions may be only slightly or not at all affected; elsewhere hyperplasia marked. Colloid accumulation, in areas where extensive, may press on and collapse neighbouring acini, causing surrounding area of *atrophy*, which by itself or with subsequent *fibrosis* forms a *capsule*.

Cycle as above can be repeated many times. Further changes with subsequent cycles:—

1. *Atrophy* of areas of epithelium from exhaustion after repeated hyperplasia: followed by *fibrosis* in area.

2. *Nodular* areas of response to stimulus: limited by surrounding atrophy, fibrosis, or capsule: may be hyperplasia or colloid nodule.

DEVELOPMENT IN MAN.—Changes are comparable to above.

FIRST CYCLE.—Normal thyroid gland at onset.

Stage 1.—Stimulus (i.e., iodine-deficiency) present: hyperplasia results. If stimulus persists without iodine administration produces '*chronic diffuse parenchymatous goitre*', common in endemic, rare in sporadic group.

Stage 2.—Stimulus ceases or is compensated by giving iodine. Results: (i) *Involution* of proliferated epithelium; (ii) *Colloid* accumulation (further thins some

epithelium by pressure). May produce '*diffuse colloid goitre*'; more commonly irregular areas of (a) colloid, (b) atrophied epithelium or vesicles, (c) normal tissue.

SECOND CYCLE.—Stimulus recurs. Onset and cessation repeated. Gland not normal at onset, and response irregular in distribution and character.

FURTHER CYCLES of presence and absence of stimuli will result in development of various combinations of areas as follows:—

1. *Colloid vesicles and areas.*
2. *Epithelium.*—Areas of (a) partial and varying hyperplasia, (b) atrophy.
3. *Atrophy.*—From (a) exhaustion of epithelium, (b) pressure of colloid, (c) contraction of fibrous tissue.
4. *Fibrosis.*—From organization of (a) proliferated connective tissue, (b) collapsed and atrophied areas.
5. *Nodules.*—Atrophy and fibrosis as above results in isolation of circumscribed areas still capable of response to stimuli: enlargement of such areas results in *nodules*, i.e., produces '*nodular goitre*'. The nodules may be (a) parenchyma or colloid, and (b) single or multiple, resulting in various types of nodular goitre: a single nodule may clinically be an '*adenoma*'.
6. *Cysts.*—Colloid distension of acini may cause extreme thinning and atrophy of epithelium and then rupture and coalescence of vesicles, finally forming a *colloid cyst*. Hæmorrhage into cavity produces *hæmorrhagic cyst*. Other degenerative changes also occur.

SUMMARY OF STAGES.—

1. Excessive secretion demanded: hyperplasia results.
2. Need for over-activity subsides (by cessation of stimulus or compensation): involution to colloid or resting stage.
3. If need for over-activity is sufficiently prolonged: atrophy from exhaustion, in areas.
4. If cycle frequently repeated: much gland cannot respond; tissue responding forms '*nodules*' or '*adenoma*'.

Classification of Simple Goitre.—

TYPES.—(1) Parenchymatous; (2) Colloid.

DISTRIBUTION.—(1) Diffuse; (2) Nodular, multiple or single; (3) Adenoma.

Either type may have any of the distributions.

DEGENERATIONS.—Parenchymatous: (in adenoma) hyaline, necrosis. Colloid: cysts.

Distinguishing Features of Parenchymatous and Colloid Goitre.—

PARENCHYMATOUS GOITRE.—

OCCURRENCE.—Diffuse forms common in endemic, rare in sporadic goitre. At any age. May be hypothyroidism (i.e., myxœdema): (children often cretins).

In diffuse forms, enlargement general and may be enormous. In nodular and adenomatous types, enlargement localized—e.g., one lobe or isthmus.

Parenchymatous Goitre, continued.

ON SECTION.—Pale. Vesicles small and numerous. Epithelium cubical or high columnar: some folding. Colloid scanty.

IODINE.—Diminished: both per gram and in total amount.

Gudernatsch test may be negative

COLLOID GOITRE.—

OCCURRENCE.—Commonest type found on removal in (1) puberty and pregnancy goitres, (2) sporadic goitres, also in (3) parenchymatous goitre after treatment with iodine. Diffuse form rare after age of 30.

ON SECTION.—Pinkish. Coarsely lobulated. Vesicles large; colloid in excess; epithelium flat, may be remains of proliferation.

IODINE.—Diminished per gram weight, but total in gland increased.

Gudernatsch test positive.

Symptoms.—Attention first attracted by size of neck. Any thyroid causing a swelling on neck is enlarged. Symptoms result from pressure: not closely related to size of swelling, but to (1) nodular goitres (with fibrosis), especially when unilateral, and (2) 'substernal goitres'. *Effect on trachea*: Chiefly lateral compression (anterior-posterior with neoplasms). Other structures *displaced* rather than compressed.

CHARACTERISTIC SYMPTOMS.—(1) *Dyspnœa*: predominant symptom; especially at night; from tracheal pressure; cough not uncommon. Less frequently: (2) Hoarseness: from recurrent laryngeal nerve. (3) Dilated pupils: pressure on sympathetic nerve.

OTHER SYMPTOMS are not common, and if marked suggest neoplasm. Occasionally: dysphagia; congestion of veins of neck (œdema rare). Sudden increase in size suggests hæmorrhage or neoplasm.

Substernal Goitres.—Goitres extending downwards behind sternum: common with adenoma. Cause deflexion and lateral compression of trachea; sensation of suffocation at night; dyspnœa may be paroxysmal and fatal; inspiratory stridor. Diagnosed by skiagrams. Dangerous even when small.

Course and Prognosis.—Puberty goitres commonly subside without treatment; also pregnancy goitre. Small soft goitres in young people often recover on leaving goitrous district, but not old or fibrous forms.

COMPLICATIONS.—(1) Pressure effects. (2) Hæmorrhage into cysts. (3) Secondary thyrotoxicosis may develop (*see* p. 882). (4) Hypothyroidism: may develop with old goitres. (5) Malignant disease—usually sudden rapid growth. (6) Goitre heart (of Rose): tachycardia, etc., may develop in subjects over middle-age: cause formerly disputed: probably usually toxic. (7) Psychosis: nervous symptoms not uncommon following discovery of goitre. Life not otherwise shortened.

Diagnosis.—Differentiation of various types of simple goitre not always possible.

MALIGNANT NEOPLASM.—Usually: (1) Rapid growth; (2) Hard; (3) Fixed. Tends to compress trachea antero-posteriorly. Diagnosis often at fault.

HYPERTHYROIDISM: THYROTOXICOSIS.—By symptoms, and by thrills and murmurs over goitre. In secondary type, often difficult.

RIEDEL'S DISEASE.—Growth hard and smooth.

Prophylaxis.—In endemic areas:—

1. **PROVISION OF IODINE.**—Methods: (a) Sodium iodide, gr. 3 daily for 10 days spring and autumn; (b) Iodized table salt; (c) Iodized water—1 lb. sodium iodide to ten million gallons.
2. **PROVISION OF PURE WATER.**

Treatment.—

MEDICAL TREATMENT.—

IODINE.—Give Lugol's iodine, ℥ij to v, t.d.s., in water: for weeks or months. Results variable, but may be successful.

Note.—Toxic symptoms, i.e., hyperthyroidism, may develop: iodine to be omitted. Adenoma supposed to be particularly liable to become toxic.

THYROID EXTRACT.—Occasionally effective.

X RAYS.—No effect.

THYROIDECTOMY.—Indicated for pressure: also for cosmetic reasons. *Contra-indicated* in puberty and early goitres (remainder of thyroid will again and repeatedly hypertrophy). Risk of neoplasm is not sufficiently great to be an indication.

V. HYPOTHYROIDISM.

(*Myxœdema and Cretinism.*)

Clinical Types.—(1) *Myxœdema*, acquired hypothyroidism. (2) *Cretinism*, congenital hypothyroidism; sporadic and endemic. Both types are due to deficiency of thyroid secretion.

1. MYXŒDEMA.

Characterized clinically by defective metabolism and mental changes, and pathologically by atrophy and fibrosis of the thyroid gland.

Etiology.—

AGE.—Onset most frequent from 30 to 50 years.

SEX.—Females 6 to males 1. No special relation to sexual functions.

HEREDITY.—No obvious influence.

EXCITING CAUSE of the fibrosis and atrophy of gland.—Unknown.

Neither alcohol nor syphilis. Occasionally: Conditions causing atrophy and fibrosis of glands: (1) Exophthalmic goitre; (2) Diffuse parenchymatous goitre (especially endemic); (3) Lymphadenoid goitre.

CACHEXIA STRUMIPRIVA.—Following complete thyroidectomy. Amenable to thyroid treatment. Tetany if parathyroids injured.

Myxœdema, continued.

Morbid Anatomy.—

THYROID GLAND.—Fibrosis and atrophy: weight often 3 to 5 gm. instead of 30. Enlarged rarely.

SUBCUTANEOUS ŒDEMA.—Presence of excessive mucin formerly described, but is doubtful. Explanation of the swelling unsettled: possibly a form of granulation tissue.

OTHER CHANGES (not constant).—Enlargement of hypophysis. Myocarditis and arteriosclerosis (in advanced types).

Symptoms.—Characterized by slowness in all functions, mental, muscular, and metabolic.

ONSET insidious. *Early complaints:* Increased bulk, languor, coldness.

'SOLID ŒDEMA'.—Characteristic swelling of subcutaneous tissues; does not pit on pressure. Increases bulk and alters appearance. Distribution general, but marked where tissues lax, e.g., 'supraclavicular pads'.

PHYSIOGNOMY.—Expressionless features, broad and bloated. Eyelids puffy and drooping. Lips and nostrils thick. General yellow tint, with red patch on cheek ('strawberries and cream'). Appearance usually characteristic.

SKIN.—Dry and rough. No sweating. *Hair* sparse and dry.

GAIT AND ALL MOVEMENTS.—Slow and deliberate. *Hands and feet* large and flat.

MENTAL CONDITION.—Cerebration slow. Memory defective. Speech slow and muffled. Deafness not uncommon. Often irritable. Headache. Rarely visual and other hallucinations and finally dementia.

ALWAYS COLD; better in warm weather. **CONSTIPATION.** **ANÆMIA** moderate.

PULSE slow and regular. When disease advanced, sometimes chronic myocarditis. Blood-pressure may be high.

TEMPERATURE low.

URINE.—Slight albuminuria not uncommon; rarely glycosuria.

THYROID GLAND impalpable.

MENSTRUATION irregular. **STERILITY** not invariable.

BASAL METABOLIC RATE reduced 20 to 40 per cent.

CARBOHYDRATE TOLERANCE usually increased.

Note.—Minor degrees not uncommon in women, age 40 to 60 years. Mild symptoms: removed by treatment.

Progress in Absence of Treatment.—Slowly progressive over many years. Death from intercurrent disease: tuberculosis, myocarditis, or nephritis.

Diagnosis.—Simple in marked cases. Early diagnosis now expected. Diagnosis from:—

CHRONIC NEPHRITIS.—Resembles myxœdema in pallor, swelling, and albuminuria. Differs in absence of solid œdema, dry skin and hair, changed mental condition.

OBESITY.—Sweating marked, and patient prefers cold weather. Differs from 'solid œdema'.

Treatment.—

THYROID GLAND.—Initial dose (dry gland: *thyroideum siccum*), gr. $\frac{1}{2}$ b.d.; increase as necessary. Maximum dose rarely exceeds gr. v daily.

PROGRESS UNDER TREATMENT.—(1) *Loss of weight*: best measure of dosage: often loss of 2 to 4 stone. (2) Symptoms disappear, and recovery almost complete—permanent if thyroid continued.

HYPERTHYROIDISM.—If dosage excessive, tachycardia and other symptoms develop: reduce dose.

MYOCARDITIS.—Keep in bed at onset of treatment if cardiac symptoms present.

RELAPSES on omitting thyroid are equally controlled on resumption.

2. CRETINISM.

Commences in infancy. Characterized clinically by defective development mentally and bodily, and pathologically by absence or disease of the thyroid gland.

Varieties.—Two forms occur, essentially the same: (1) Sporadic; (2) Endemic.

1. SPORADIC CRETINISM.—

ETIOLOGY.—Females 60 per cent. No known factors.

MORBID ANATOMY.—

Thyroid Gland.—(1) Absent: most common. (2) Advanced fibrosis and atrophy: less common. (3) Goitre: very rare (cf. ENDEMIC CRETINISM).

Skeletal changes.—Growth arrested, bones thick and short. Rough resemblance to rickety bones, but epiphyseal cartilages show, not proliferation, but deficient growth and delayed ossification.

Thymus often persistent. *Hypophysis* sometimes enlarged. No visceral changes.

SYMPTOMS.—Rarely noticed before six months; then deficient growth, mental dullness, large tongue, and dry skin. By second year symptoms definite; subsequently develop fully.

Growth stunted.—Full-grown cretin rarely exceeds 4 feet.

Bodily proportions abnormal.—Head large; neck short; breast flat; vertebræ curved. Hands and feet 'spade-like.' Abdomen prominent; umbilical hernia common. Fontanelles close late.

Oedematous appearance: does not pit. *Anæmia* moderate.

Physiognomy.—Face broad and puffy. Eyes wide apart; lids swollen. Nose flat. *Alæ nasi* thick; nostrils wide open. Tongue protruding; mouth open; dribbling common.

Skin dry: sweating rare. *Hair* coarse and scanty.

Teeth: dentition delayed, early caries. *Nails* brittle.

Sexual organs small

Sporadic Cretinism—Symptoms, continued.

Mental condition apathetic.—Stolid, but easily amused; infrequently, vicious. Speech, very slight. Deafness common. In advanced stages, may be imbecile.

Muscular weakness marked.

Always cold. Constipation. Temperature often subnormal.

Note: Symptoms as above in severe forms. Milder cases more common.

VARIATIONS.—'Juvenile myxœdema': onset in childhood. Cretinism with goitre. In both forms, symptoms usually partial.

2. **ENDEMIC CRETINISM.**—Occurs where goitre is prevalent; etiology similar. When a family enters goitrous district, goitre appears in first generation, and cretinism in later ones.

MORBID ANATOMY.—Goitre present at birth in 60 per cent.

Histology: atrophy and fibrosis.

SYMPTOMS.—As in sporadic type.

Diagnosis.—Simple in marked cases. From:—

MONGOLIAN IDIOCY.—Eyes placed obliquely. Restless. No subcutaneous thickening. Often later child in large family. No improvement with thyroid extract.

Other difficulties may be: Mental deficiency. Encephalitis. Infantilism. Rickets.

Prophylaxis.—Pregnant women in endemic areas to be given iodine.**Treatment.**—

THYROID GLAND.—Two stages in treatment: (1) To cure the disease; (2) To prevent recurrence. Treatment must continue for life. For each subject, correct dosage found by experiment and progress as below. Commence with thyroideum siccum gr. $\frac{1}{4}$ daily, and increase until efficient; rarely exceeds gr. iij. With continuation of excessive dosage, symptoms of hyperthyroidism occur.

PROGRESS UNDER THYROID TREATMENT.—(1) *Initial loss of weight*, from reduction of œdema; then gain as growth proceeds. (2) *Growth in height*; often several inches in first six months. (3) *General mental and bodily development*, tending to removal of symptoms of condition, but rarely complete; degree of recovery varies inversely with age at commencing treatment; if over ten years, child tends to remain 'younger than his age', and mental condition may be impaired.

If untreated, life rarely exceeds 30 to 40 years.

VI. HYPERTHYROIDISM. THYROTOXICOSIS.**Clinical Groups.**—

1. Primary thyrotoxicosis: exophthalmic goitre: primary Graves' disease.
2. Secondary thyrotoxicosis (previous goitre): toxic adenoma.

Note.—Condition of gland is not invariably an 'adenoma'.

Both groups are due to over-activity of thyroid gland: secretion probably only excessive: no evidence of abnormality.

IDENTITY OF THE TWO GROUPS.—Disputed. Supporters of two groups note in secondary thyrotoxicosis: (1) Exophthalmos rare and slight; (2) Cardiac symptoms marked. Against, it is argued that at later age of onset myocardial degeneration has occurred and heart is easily affected; but similar clinical features and an adenoma may follow puberty goitre. The two groups are here described separately.

Stimuli causing Thyrotoxicosis.—Uncertain, but following are factors:—

1. **IODINE.**—Can certainly convert a simple adenoma into toxicity.
2. **NERVOUS SHOCK.**—(But incidence in males not increased during War.)
3. **INFECTIONS.**

Not common with endemic goitre.

(Initial stimulus may be from anterior lobe of pituitary.)

Development of Thyrotoxicosis.—General train of pathological changes in gland resemble those in SIMPLE GOITRE (*see* p. 870). Hyperplasia, colloid resting stage, atrophy, fibrosis, nodules, adenoma—all occur and develop in thyrotoxicosis as in simple goitre, depending on cycles, duration and severity of response, but further also influenced by condition of gland before onset of presumed thyrotoxic stimulus. Hyperplasia and vascular dilatation are more marked than occurs in simple goitre, but degree of toxic symptoms cannot be accurately judged from the pathological changes.

Iodine, Thyroxin, and Thyrotoxicosis.—

IODINE IN GLAND.—Greatly reduced in hyperplastic gland: ascribed to diminution of colloid by rapid absorption into circulation. In 'colloid stage' (from administration of iodine or in retrogression) iodine is increased.

IODINE IN BLOOD.—In toxic stage, increased seven times (due to thyroxin).

Provisional Summary of Types of Response to Stimulus.—

1. **IF WHOLE GLAND NORMAL.**—All of gland responds to stimulus. Results in *primary thyrotoxicosis*.

Effect of Thyroidectomy.—Good (if removal extensive); may recur.

2. **IF GLAND IN 'COLLOID GOITRE' (simple goitre).**—Epithelium to varying extent is exhausted or atrophied and cannot react as normal gland.

a. IF EARLY COLLOID STATE.—Response is universal hyperplasia of epithelium, but to less degree than in normal gland. Result: *secondary thyrotoxicosis*.

Effect of Thyroidectomy.—Remaining tissue hypertrophies and clinical features return. Thyroidectomy (unless complete) should be postponed until evidence of or interval for fibrosis formation.

Note.—This type often follows 'puberty' or 'adolescent goitre'. Hyperplasia not always universal; may be

Thyrototoxicosis—Types of Response to Stimulus, *continued*.

partial (from irregular degrees of response or condition of epithelium), thus producing an indefinite or a definite '*toxic adenoma*'. Possibly due to iodine deficiency. Tends to subside. Must not be operated upon, as condition will recur.

- b. IF LATER COLLOID STAGE.—Some fibrosis already present and gland irregularly firmer: response produces *nodules* of hyperplasia.

Effect of Thyroidectomy.—Satisfactory.

- c. IN LATE STAGES (e.g., over 40 years of age).—Fibrosis present and even less epithelium to respond: response produces '*toxic adenoma*'.

Effect of Thyroidectomy.—Very good. Recurrence rare.

1. PRIMARY THYROTOXICOSIS: EXOPHTHALMIC GOITRE.

(*Graves', Basedow's, or Parry's Disease.*)

A disease characterized clinically by enlargement of the thyroid gland, exophthalmos, tachycardia, tremor, and metabolic disturbances, and pathologically by overactivity of the thyroid gland.

Etiology.—

SEX.—At least 10 females to 1 male.

AGE.—Usually between puberty and the menopause.

HEREDITARY INFLUENCES.—Often several in one family affected. Hysteria and nervous conditions common in family.

EXCITING CAUSES.—Uncertain. See p. 877.

Morbid Anatomy.—

THYROID GLAND.—General enlargement. Superficial vessels are large and distended. Substance soft. Cut surface lacks gelatinous appearance.

HISTOLOGY.—*Great increase in epithelium and supporting tissue, and absence of colloid.* Cells cubical or low columnar. Alveoli of various sizes: projections ('*plication*') of epithelium run into lumen; many cells desquamated. Changes usually diffuse, less often focal. Gland in condition of great secretory activity. *Rarely*, in severe cases, colloid increased.

IODINE CONTENT IN THYROID GLAND.—See p. 877.

IN LATER STAGES.—Colloid present; epithelial hyperplasia less marked. Areas of fibrosis and atrophy.

AFTER TREATMENT WITH IODINE.—Gland resembles colloid resting stage (see p. 870).

THYMUS.—Enlarged, extending to or over pericardium. Structure normal.

EXOPHTHALMOS.—Only change is increased fat in orbit.

Cervical glands always enlarged at operation or autopsy.

No constant changes in sympathetic ganglia, parathyroids, hypophysis, or central nervous system.

Pathogenesis.—*Excessive formation and absorption of secretion of the thyroid gland—i.e., hyperthyroidism.* Supported by:—

1. Symptoms are antithesis of myxoedema.
2. Thyroid or thyroxin administration in excess (e.g., for obesity) produces similar symptoms—except exophthalmos in man (observed, however, in monkeys and dogs).
3. Thyroid or thyroxin administration aggravates exophthalmic goitre.
4. Symptoms improve on removal or reduction of gland.
5. Gland is in condition of secretory activity: resembles small portion left in animals after experimental removal.

PATHOGENESIS OF EXOPHTHALMOS.—*See p. 899.*

Symptoms.—

ONSET.—Usually gradual. Main symptoms may arise simultaneously or in sequence. Rarely, onset acute: cardiac symptoms severe, often fatal. *Facies*: thin, with startled expression.

CHARACTERISTIC SYMPTOMS.—(1) Enlargement of the thyroid; (2) Tachycardia and circulatory disturbances; (3) Exophthalmos; (4) Tremor; (5) Metabolic disturbances. Other important symptoms are nervousness, sweating, wasting, headache. Patient complains of one or more of these (rarely of tremor).

1. **ENLARGEMENT OF THE THYROID.**—Uniform, or right lobe larger than left. Rarely very large. Soft. No tenderness.

Inspection.—Often visible pulsation, from vascularity, or transmission from carotids.

Palpation.—Thrill not uncommon.

Auscultation.—Loud murmur, systolic, double, or continuous (*bruit de diable*).

Pressure symptoms very rare unless retrosternal. Size may vary from time to time: not always related to severity of symptoms.

2. **TACHYCARDIA AND CIRCULATORY DISTURBANCES.**—

Tachycardia.—Pulse 100–160, regular. Most constant symptom. Rapidity easily increased. *Palpitation* common.

Cardiac Signs.—Area of pulsation increased and forcible. Heart-sounds very loud. Murmurs rarely absent: apical systolic or at base, especially 2nd left space.

Visible Pulsation in Arteries in Neck.—Often extreme. Also pulsation in peripheral vessels and veins, and flushing of head and neck.

Atrial Fibrillation.—Common in severe forms: when definitely established, never permanently ceases unless thyroidectomy performed. *Extrasystoles* and other irregularities may occur.

Blood-pressure.—At onset high, then falls, later rises again. Pulse pressure (difference between systolic and diastolic) increased above normal 40 when blood-pressure high.

In severer forms, cardiac failure.

Primary Thyrotoxicosis—Symptoms, *continued*.

3. EXOPHTHALMOS AND OCULAR SYMPTOMS.—

Exophthalmos.—Staring expression. May be unilateral. Eyeballs protruded, lids retracted. Cause unknown, possibly spasm of orbital muscle of Müller or increased intra-orbital fat. Usually last symptom to disappear.

Vision normal. (For development, *see* p. 899.)

Von Graefe's Sign.—On looking down, upper eyelid lags or descends in jerks, sclerotic becoming visible.

Stellwag's Sign.—Infrequent blinking.

Dalrymple's Sign.—Wide palpebral fissure; spasm of levator palpebræ superioris.

Möbius' Sign.—Lack of convergence for near objects. No diplopia.

Joffroy's Sign.—On looking upwards, no wrinkling of occipitofrontalis.

4. TREMOR.—Fine. Involuntary. Affects whole extremity. Often unnoticed by patient.

5. METABOLIC DISTURBANCES.—

a. *Basal Metabolic Rate*.—Increased 20 to 80 per cent. Read's formula:—

$$\text{B.M.R.} = 0.683 (\text{P.R.} + 0.9 \text{ P.P.}) - 71.5$$

where P.R. is resting pulse-rate and P.P. is resting pulse-pressure; result is positive or negative B.M.R. percentage figure. (Error considerable: no factor for body superficies.)

b. *Sugar Tolerance*.—Diminished. May be glycosuria: often high threshold.

c. *Skin moist*. *Wasting*: may be severe.

d. *Calcium and Phosphorus Excretion*.—Increased, and osteoporosis present (*see* p. 895).

OTHER SYMPTOMS, rarely absent.—*Nervousness*; irritability. *Sweating*, and flushing; dislikes heat, better in cold. *Headache*: often connected with vascular throbbing. Amenorrhœa and irregular menstruation. Reflexes brisk.

RETROSTERNAL GOITRE.—Causes pressure symptoms: stridor, dyspnœa especially at night. May be dullness over sternum. Radiographs may show deflection of trachea. Indicates operation.

VARIOUS AND OCCASIONAL SYMPTOMS.—Slight *pyrexia*. *Pigmentation* of skin and leucoderma. Vomiting, less often diarrhœa (may be serious). *Blood*: relative lymphocytosis (often absent).

ACUTE THYROID CRISIS.—Sudden onset: pulse very rapid, delirium or acute mania, exhaustion. Gland often enlarges rapidly and other symptoms increase (but not invariably). May be diarrhœa and vomiting. High mortality.

Progress.—Condition tends to advance to a maximum in about a year. Course prolonged, with remissions and exacerbations: may last many years and wear out. About 25 per cent formerly died, but less with modern treatment. About 50 per cent practically recover. Remainder become chronic. 'Relapses' common: usually incomplete recovery in interval. *Myxœdema* may

gradually develop. *Prognosis* bad with: severe wasting, myocardial weakness, persistent vomiting or diarrhoea, diabetes, acute crises.

EFFECT OF PREGNANCY.—Effects vary: often good.

Diagnosis.—Usually simple on inspection, viz., exophthalmos and prominent thyroid. Never diagnose (if untreated) with normal pulse-rate, pulse-pressure (40), or basal metabolic rate.

DIFFICULTIES.—(1) Slight grades; (2) Early pulmonary tuberculosis; (3) Simple goitre with neurosis; (4) Hysterical tremor with rapid pulse.

Treatment.—

1. MEDICAL TREATMENT.—

- a. **REST.**—In quiet surroundings, in severe cases in bed, for 6 weeks to several months. *Diet*: mixed, with milk and fruit.
- b. **SEPTIC FOCI.**—To be treated or removed.
- c. **SPECIAL SYMPTOMS.**—(i) *Wasting*: insulin injections (5 to 10 units daily), with glucose by mouth. (ii) *Nervousness*: quinine hydrobromide gr. v to x t.d.s. (iii) *Cardiac weakness or auricular fibrillation*: digitalis, quinidine.
- d. **IODINE.**—Rapidly reduces basal metabolic rate and causes marked clinical improvement. On continuation, symptoms tend to increase again, but not to early severity, and amelioration follows. Converts hyperplastic goitre into colloid resting stage. Should not be stopped suddenly, as definite recrudescence may occur (often mistaken for iodism).

Simple preparations preferable: Lugol's iodine ℥iij to v, t.d.s., in milk or water (does not keep in dilution, but dose easily measured from stop bottle).

Should be given for long periods, but if thyroidectomy anticipated, iodine is best kept for preparation for operation to obtain maximum rapid effect.

2. THYROIDECTOMY.—

INDICATIONS.—No improvement on medical treatment; cardiac weakness or auricular fibrillation persists or returns; large glands. Extensive resection advisable. Remaining tissue may hypertrophy and second operation be necessary; results usually good.

CONTRA-INDICATION.—Early cases of secondary thyrotoxicosis (previous goitre) with general enlargement and absence of fibrosis: repeated recurrences follow operation.

PRELIMINARY TREATMENT.—Rest; treatment of septic foci. *Iodine* for 3 weeks before operation (and several weeks subsequently).

Operative risks variously stated.

Note: If cardiac disturbances have been prolonged, recovery will necessarily be slow.

3. **X-RAY APPLICATIONS TO GLAND.**—Improvement mainly in early, soft, hyperplastic glands. Causes fibrosis, and gland more suitable for thyroidectomy; but may cause fibrosis of capsule, and adhesions.

2. SECONDARY THYROTOXICOSIS.*(Toxic Adenoma.)*

The development of thyrotoxic symptoms with a previous goitre.

Pathogenesis and Types.—

1. TRUE 'TOXIC ADENOMA'.—Occurring in middle-aged subjects with old nodular goitres.

2. SECONDARY THYROTOXICOSIS.—Occurring in (a) younger subjects, or (b) with previous soft diffuse goitres.

SYMPTOMS.—Thyroid gland: diffuse enlargement or roughly adenomatous. Otherwise as for 'toxic adenoma'.

COURSE AND TREATMENT.—Subsides with rest and iodine. *Thyroidectomy* contra-indicated, as further portions will hypertrophy repeatedly and symptoms return. (*Note.*—Gland may fibrose with duration or with X-ray and iodine treatment, and operation then be practicable if necessary.)

Note.—Remainder of section applies to 'toxic adenoma'.

Etiology.—Usually after middle-age. Males rare.

Morbid Anatomy.—Proliferation of epithelium absent or slight. Vesicles contain colloid: epithelium may be flattened. No specific evidence of 'toxicity'.

Symptoms (differences from primary thyrotoxicosis).—

THYROID GLAND.—Nodular. Adenoma distinct: one or more.

SYMPTOMS ABSENT.—Exophthalmos and eye signs. Acute crises. Nervous phenomena slight. Basal metabolic rate shows only a moderate rise.

MARKED SYMPTOMS.—Cardiac disturbances: auricular fibrillation frequent, and signs of myocardial weakness.

Course.—Chronic but progressive without remissions. Cardiac failure commonest fatality.

Treatment.—

MEDICAL TREATMENT AND X RAYS.—Unsuccessful. Auricular fibrillation never yields permanently.

IODINE.—May have good effect, but not constant or permanent. Ill effects in dispute. Best use is for 3 weeks before and after operation, especially if not given previously.

THYROIDECTOMY.—Indicated in general, especially if auricular fibrillation. Previous period of rest and iodine.

OPERATION RISKS.—Mainly from heart; delirium uncommon.

RESULTS.—Very good. Recurrences rare. Cardiac weakness may remain or improve but slowly (from permanent myocardial degeneration).

VII. RIEDEL'S DISEASE.*(Ligneous Thyroiditis.)*

Fibrosis of the thyroid gland of unknown origin, extending to surrounding structures, and producing symptoms by pressure, without hypothyroidism. Rare.

Etiology.—Both sexes. Goitre previously present in many cases. Syphilis not a factor.

Morbid Anatomy.—Growth forms white, intensely hard mass: spreads through glands and to surrounding structures. Consists of dense avascular connective tissue; areas of leucocytic infiltration; vessels show obliterating endarteritis. Epithelium proliferates and then atrophies from pressure; giant cells may form ('pseudo-tuberculosis of thyroid'). May be normal tissue in parts. Suggests chronic inflammation.

Symptoms.—

THYROID GLAND.—Hard mass, smooth surface. May commence locally in one lobe; gradually extends through gland and neighbouring structures.

SKIN.—Not involved.

LYMPHATIC GLANDS.—Not enlarged.

PRESSURE SYMPTOMS.—Dyspnoea, pain, etc. No hypothyroidism.

Course.—Slow extension.

Diagnosis.—From neoplasm. May be impossible. Note hardness and smooth surface.

Treatment.—Remove, as possible.

VIII. LYMPHADENOID GOITRE.

Diffuse lymphocytic infiltration of the thyroid gland leading to hypothyroidism. Rare disease. Cause unknown.

Etiology.—In women over 45 years. No previous goitre.

Morbid Anatomy.—*Thyroid gland*: firm, smooth; diffuse infiltration with lymphocytes; little normal tissue remains; later, atrophy and fibrosis.

Symptoms.—

THYROID GLAND.—Moderately enlarged, smooth. Skin and surrounding structures not affected.

MYXŒDEMA develops.

Pressure effects absent or slight.

Course.—Slowly progressive.

Treatment.—As for myxœdema.

CHAPTER CLX.

DISEASES OF THE PARATHYROID GLANDS.

I. MORPHOLOGY AND FUNCTIONS.

The parathyroid glands, commonly four in number, are arranged in two pairs, external and internal, along the posterior inner border of the lateral lobes of the thyroid. In man, never included in thyroid gland: connected developmentally with thymus rather than thyroid. Size: not exceeding $\frac{1}{2}$ in. in length and $\frac{1}{8}$ in. in breadth. Colour: yellow to brown (later life).

Morphology and Functions of the Parathyroid Glands, continued.

Development.—From entoderm of: (a) IIIrd branchial cleft—internal pair; (b) IVth branchial cleft—external pair, smaller than internal.

Histology.—(1) 'Chief cells'. Large spherical cells, unstaining cytoplasm, central nucleus containing 2 to 6 nucleoli; in later life, some contain lipid granules. (2) A few similar but granular cells staining with eosin. (3) Oxyphil cells with small nucleus; after 10 years of age; probably not secretory.

Functions.—The parathyroids are ductless glands with internal secretion ('parathormone'—Collip). Parathormone controls the supply of circulating calcium and phosphorus as needed by the tissues, and for this end influences the withdrawal of calcium and phosphorus from the stores in spongiosa of the bones, and thus affects: (1) Condition of the bones; (2) Production of tetany, by hypocalcæmia; (3) Production of hypercalcæmia. (See also CALCIUM and PHOSPHORUS METABOLISM, p. 894.)

PARATHYROID EXTRACT.—Prepared by Collip, 1924: known as 'parathormone'. Oral administration useless.

INTRAMUSCULAR INJECTIONS IN ANIMALS.—

Effects on Metabolism.—(1) Blood calcium rises (hypercalcæmia); (2) Plasma phosphorus falls; (3) Excretion of calcium and phosphorus increased in urine. If injections are large and continued, plasma phosphorus later rises (also blood urea) and then ceases to be excreted. Primary effect probably on phosphorus.

Results.—(1) Tetany of total parathyroidectomy abolished; (2) Toxic symptoms, diarrhoea, drowsiness, muscular weakness, coma; (3) Bone changes resembling generalized osteitis fibrosa.

INTRAMUSCULAR INJECTIONS IN MAN.—Effective in post-operative tetany by raising blood calcium: loses effect on frequent repetition. Hypercalcæmia less constant after large doses than in animals. No toxic symptoms noticed.

Lesions of the Parathyroid Glands.—Can be considered in relation to under- and over-activity of internal secretion.

HYPOPARATHYROIDISM.—

OCCURRENCE.—(1) Parathyroidectomy: accidental in total thyroidectomy. (2) Spontaneous (cf. myxœdema): very rare.

EFFECTS ON METABOLISM.—(1) Blood calcium falls: hypocalcæmia. (2) Plasma phosphorus rises. (3) Excretion of calcium: falls in urine; unaffected in fæces. (4) Bones: no loss of calcium or phosphorus.

MANIFESTATIONS.—(1) *Tetany*. (2) Lesions of ectodermal tissues: cataract, opacities in the lens (seen by use of slit lamp), loss of hair, ridging of the nails and brittleness, defects in enamel of teeth.

HYPERPARATHYROIDISM.—

OCCURRENCE.—(1) Parathyroid tumour. (2) Excessive injection of parathormone (experimental in animals).

PARATHYROID TUMOUR.—Usually only one parathyroid affected. Histology: adenoma. Rarely palpable externally.

Effects on Metabolism.—(1) Blood calcium rises (hypercalcaemia). (2) Plasma phosphorus falls. (3) Excretion of both increases, mainly in urine. (3) Bones: continued depletion of stored skeletal minerals.

MANIFESTATIONS.—(1) *Generalized osteitis fibrosa*: continued depletion of stored skeletal minerals results in fibrous substitution in the rarefied skeleton (*see below*). (2) *Hypercalcaemia*: results in metastatic calcification, primary calculi.

II. GENERALIZED OSTEITIS FIBROSA.

A diffuse disease of the skeleton characterized by softening of bones, and formation of tumour-like masses and cysts due to disturbance of calcium metabolism and bone formation associated with hyperparathyroidism.

No relation to localized osteitis fibrosa, osteitis deformans, or osteomalacia. Von Recklinghausen, 1891, separated it from osteomalacia and diffuse bone dystrophies. Hoffheinz, 1925, proved connection with parathyroid tumours.

Etiology.—Sex: females commoner than males, two to one. Age: females, 50 years; males, 40 years.

Pathogenesis.—Ascribed to hyperparathyroidism. Over-secretion of parathormone assumed to stimulate excessive osteoclastic lacunar resorption of bone, mineral salts being then excreted into blood in excess of requirements and thus depleting skeleton. High urinary excretion of calcium is secondary to the hypercalcaemia.

Jaffe and Bodansky produced similar changes experimentally with parathormone.

Malignant tumours of parathyroids are not associated with skeletal changes.

Parathyroid Glands.—Tumour found at operation (few exceptions): usually only one gland affected. 'Chief' and eosin cells involved. Gland suggests hyperplasia or adenoma rather than neoplasm.

Morbid Anatomy of Bones.—No bone immune, but different degrees at various sites. Long bones specially affected. Femur shows S-shaped deformity; pelvis, beak-shaped. Bones thick and soft, can be bent without breaking or cut by knife; deformed by bending, by fracture, and by tumour-like masses and cysts.

Morbid Histology of Bones.—

PRINCIPAL STAGES IN DEVELOPMENT.—

1. Excessive lacunar resorption of reticular bone, by osteoclasts in large numbers. Haversian canals become large spaces.
2. Fibrous tissue gradually replaces original bone.
3. Some 'new bone' develops, partly (a) of irregular type, by metaplasia from fibrous tissue, and (b) by apposition of new bone to the fibrous tissue by osteoblasts. Calcification may take place, forming spicules of bone, but may fail, leaving osteoid tissue.

Generalized Osteitis Fibrosa—Morbid Histology of Bones, *continued*.

4. New bone formed may be resorbed by osteoclasts and replaced by fibrous tissue.
5. Bone in advanced stage thus consists of fibrous tissue with spicules of new bone.

TUMOUR-LIKE MASSES.—Present in bones: may be large enough to cause deformity, or microscopic foci: consist of giant cells, in type similar to osteoclasts normally present in Howship's lacunæ: clusters of cells in ground of fibrous tissue. Colour of mass varies from yellow to red, depending on hæmorrhage and capillaries. No capsule, and shades off gradually into surrounding tissue. Microscopically resemble myeloid sarcoma (osteoclastoma), but unconnected.

CYSTS.**Calcium and Phosphorus Metabolism.—**

1. **BLOOD.**—(a) Hypercalcæmia: serum calcium 12 to 23 mgrm. per cent. (b) Plasma phosphorus low: 1 to 2.7 mgrm. per cent.
2. **EXCRETION.**—Calcium and phosphorus markedly increased in urine; little change in fæces. The skeleton salts are excreted into the urine.

PHOSPHATASE.—Increased (remains high after operation).

Symptoms.—Initial period of bone pains: duration, months to years. Period of spontaneous fractures: fracture unites slowly in months. Deformities develop from fractures, bending, and tumours. Wasting. Patient becomes bedridden: death in exhaustion.

PARATHYROID TUMOUR.—Rarely palpable. Found at operation.

RADIOGRAPHS.—Generally diminished density of bone shadows from osteoporosis. Bending and fractures. Evidence of tumours and cysts.

Complications.—

1. **METASTATIC CALCIFICATION.**—See HYPERCALCÆMIA, p. 896
2. **RENAL CALCULI.**—From excessive mineral excretion.
3. **TETANY.**—Common after operation on tumour: usually latent, but may be active: rarely fatal (*see below*).

Diagnosis.—From *localized osteitis fibrosa* (an unrelated condition) by changes in calcium and phosphorus metabolism, and widespread osteoporosis. Cases of localized osteitis fibrosa with cysts and tumours may have been the 'generalized' disease. From *osteomalacia, rheumatism, etc.*, by changes in mineral metabolism and radiographs.

Treatment.—Neck should be explored for tumour, and this removed. If not found, give vitamin D (to increase apposition of normal bone): probably of little effect. Removal of normal parathyroid of doubtful value. Phosphates neutralize experimental hyperparathyroidism.

III. TETANY.

A condition associated with a fall of calcium in the blood and characterized clinically by symmetrical tonic spasms of the extremities, with increased irritability of the muscles and nerves to mechanical and electrical stimulation.

(See also CALCIUM AND PHOSPHORUS METABOLISM, p. 892, and PARATHYROID GLANDS, p. 884.)

PATHOGENESIS.

Tetany presumably results from loss of normal control of calcium on muscles and nerves. Commonly associated with *hypocalcæmia*. Occasionally occurs when blood calcium is not reduced: attributable to only small portion being ionized and active—e.g., rickets, hyperpnoea, gastric tetany.

Note.—Guanidin, on experimental injection, produces tetanic spasms: has been suggested as cause of some forms or features of tetany. No changes recognizable in nervous system or muscles.

ETIOLOGY.

Occurs in all conditions associated with hypocalcæmia, common factors being: (1) Deficiency of vitamin D, either in diet or by defective absorption; (2) Deficiency of calcium and phosphorus in diet; (3) Hypoparathyroidism; (4) Alkalosis. Also in certain conditions attributed to interference with absorption and ionization of calcium.

Tetany is more often due to interference with absorption and circulation of calcium or vitamin D than to deficiencies in diet.

PRINCIPAL TYPES.

1. Infantile Tetany: Spasmophilia.—Commoner in bottle-fed than breast-fed infants: due to poverty of calcium in milk. Tissues in some cases probably deficient in calcium at birth. Hypocalcæmia constant: acute form 4 to 6 mgm. per cent, latent form 6 to 8. Usually but not always associated with rickets, active or healing. Attack may be precipitated by pyrexia (possibly alkalosis). Convulsions at onset of acute specific fevers are accompanied by hypocalcæmia and are possibly tetanic. Laryngismus stridulus common. Carpo-pedal spasms. May be general convulsions.

TREATMENT OF ACUTE STAGE.—(1) Calcium chloride, 1 gr., 5 per cent solution, intramuscular injection. (2) Parathormone, 10 units, intramuscular injection: repeat in one hour. (3) Calcium chloride, 2 gm., in milk: repeat thrice in 24 hours for 3 days. (4) Irradiated ergosterol: 20 to 30 drops a day. Ammonium chloride, 5 gm. in 24 hours, also used.

TREATMENT OF CHRONIC OR LATENT STAGE.—(1) *Vitamin D*: 15 drops a day while latent; blood calcium usually normal in 7 to 10 days. Continue 5 to 10 drops daily for one month. (2) Calcium lactate and calcium-rich diet. Parathormone *not* to be continued (removes calcium from store in bones).

Note: For international unit of vitamin D, see p. 369.

Tetany—Principal Types, *continued*.

2. **In Rickets.**—Hypocalcæmia not constant, and amount may be normal: possibly deficient ionization. Plasma phosphorus low. Excretion of calcium high owing to deficiency of vitamin D. Tetany may occur in (a) active rickets, (b) healing stages attributed to withdrawal of blood calcium for use in rapidly growing bone. Active or latent tetany may temporarily disappear during attack of gastro-enteritis (causing acidosis), and return on improvement.

TREATMENT.—(See INFANTILE TETANY.) Supply of vitamin D essential.

3. **Osteomalacia.**—Tetany common. Blood calcium low usually. Otherwise is adult counterpart of rickets. Latent tetany may be converted into active by pregnancy (drain of calcium for foetus) or lactation, especially prolonged (drain in milk), constituting 'pregnancy' and 'lactation' tetany. Due to deficiency of vitamin D and calcium in the diet, and absence of sunlight.

TREATMENT.—

ACUTE STAGE.—As in hypoparathyroid tetany (*see below*). Also vitamin D.

CHRONIC STAGE.—Vitamin D. Calcium lactate. Milk. Parathormone not to be continued.

4. **Hypoparathyroid Tetany.**—Known also as post-operative tetany (thyroidectomy) or tetania parathyreopriva. Rarely spontaneous. Due to inability of stores of calcium in the bones to supply the blood in the absence of parathormone. Vitamin D not involved.

TREATMENT.—Parathormone essential.

ACUTE FORM OR STAGE (Convulsions).—(1) Parathormone, 20 to 30 units, intramuscular injection: repeat within 24 hours once. (2) Calcium chloride, 20 c.c. of 5 per cent solution, intravenously (slowly): once usually sufficient (acts by producing acidosis by chloride). (3) Calcium lactate, 10 to 30 gm. by mouth (acts by supplying calcium).

CHRONIC STAGE.—(1) Parathormone: continue 10 to 25 units daily: dose varies for different persons, tends to lose effect, and larger doses necessary. (2) Calcium lactate, 10 to 30 gm. by mouth daily. (3) Milk: 4 pints daily: 50 to 100 c.c. normal HCl may be added. (4) Thyroid extract by mouth. (5) Diet: no meat (ill-effects possibly due to phosphorus).

5. **Celiac Disease: Idiopathic Steatorrhœa.**—Tetany common in celiac rickets, but this occurs only in small proportion of cases of celiac disease, and otherwise tetany is rare in this group. Due principally to deficiency of absorption of vitamin D; loss of calcium in stools as soaps is of less importance.

TREATMENT OF TETANY.—

ACUTE STAGE.—As in hypoparathyroid tetany. Also vitamin D.

CHRONIC STAGE.—Vitamin D. Calcium lactate. (Not cod-liver oil, milk, or parathormone.)

SPRUE.—Fall in blood calcium is rare. Tetany very rare.

6. Gastric Tetany.—Tetany occurs occasionally in various gastro-intestinal conditions: most definite are those associated with dilated stomach and vomiting: all forms are rare. Attributed to alkalosis, causing fall in *ionized* blood calcium.

a. PYLORIC OBSTRUCTION AND HIGH INTESTINAL OBSTRUCTION.—(i) Congenital hypertrophy. (ii) In adults: from neoplasm or ulcer. Due to loss of chloride by vomiting, producing alkalosis.

b. ATONIC DILATATION OF THE STOMACH.—Especially with repeated lavage. Ascribed to loss of chloride. Rare, but high mortality.

BLOOD CALCIUM (*a* and *b*).—Normal or slightly increased.

TREATMENT (*a* and *b*).—Treatment other than surgery is unsatisfactory and unstandardized. Chloride necessary. Try various anti-tetany methods.

c. GASTRO-ENTERITIS.—Diarrhœa and vomiting tends to acidosis, but on treatment with alkalis is susceptible to alkalosis. Tetany very rare. Treatment: suspend alkalis.

Also in cholera and severe diarrhœa.

d. MEGALOCOLON.

e. CHRONIC CONSTIPATION.

f. CYCLIC VOMITING.

} Tetany very rarely recorded.
} Few modern observations.

7. Alkalosis.—Can produce tetany by reducing ionized calcium: total blood calcium not necessarily lowered. Alkali in large doses does not produce alkalosis in normal subjects, but may with previous disturbance of acid-base equilibrium—e.g., in nephritis, pyuria, gastro-enteritis, cyclical vomiting. Knowledge at present incomplete. Conditions include:—

a. EXCESS OF ALKALIS.—Especially in alkaline treatment of peptic ulcers. Very rare. Relation to previous nephritis unknown.

TREATMENT.—Suspend alkalis.

b. HYPERPNŒA.—*See below.*

c. GASTRIC TETANY.—*See above.*

d. FIREMAN'S OR STOKER'S CRAMP.—Due to excessive loss of chloride in sweat

TREATMENT.—Add salt to drinking water (gr. v to pint).

8. Hyperpnœic Tetany.—Deep breathing 'washes out' CO_2 from blood and produces alkalosis. Blood calcium: high. Plasma phosphorus: slightly diminished. Can occur in: (*a*) Voluntary deep breathing, severe exertion. (*b*) Hysterical hyperpnœa. (*c*) Encephalitis lethargica.

TREATMENT.—Administration of CO_2 gas.

9. Nephritis.—

a. RENAL INFANTILISM.—Tetany may occur in renal rickets, developing in renal infantilism. Cause obscure: in late stages of renal infantilism, plasma phosphorus and blood-urea rise, then serum calcium falls and tetany is common: not due to lack of vitamin D; has been ascribed primarily to phosphorus

Tetany in Nephritis—Renal Infantilism, *continued*.

retention due to renal defect, but is probably general disturbance of calcium and phosphorus metabolism resulting from nephritis.

TREATMENT.—None effective: increasing blood calcium is useless.

- b. **CHRONIC NEPHRITIS.**—Factors probably as in renal rickets. Recognizable tetany very rare, except with alkalis: rarity attributed to acidosis.

10. **Epidemic Tetany.**—Recorded on the Continent. Information scanty. In Vienna outbreak tailors and shoemakers were mainly affected ('shoemaker's cramp').

SYMPTOMS.

Principal symptoms are: (1) Spasms. (2) Signs dependent on increased irritability of neuro-muscular system. In chronic cases: (3) Lesions of ectodermal tissues.

1. **Muscular Spasms.**—Are tonic, of symmetrical distribution, affect extremities mainly, and cause characteristic postures. Very painful. In mild forms, confined to lips, hands, and feet.
- a. **BRONCHIAL AND LARYNGEAL SPASM.**—Attacks of difficult breathing. In infants as laryngismus stridulus. Face and lips may feel tight in attack, causing difficulty in speech and swallowing.
- b. **'CARPO-PEDAL SPASMS'.**—Most characteristic in infants. Hands in 'accoucheur's position': fingers flexed at metacarpophalangeal joints, extended at others: fingers pressed together and margins of hand approximated by spasm of thenar and hypothenar muscles. Thumb folded across palm, or pressed against forefinger. Wrists often flexed. Ankles dorsiflexed. Toes flexed. Hands and feet swollen, tender, and hot.
- c. **EXTENSIVE SPASMS.**—In severe cases. Elbows flexed, arms crossed over chest. Knees extended. Abdomen rigid. Rarely spasm of diaphragm, with cyanosis and dyspnoea, and of pharynx. Occasionally in adults, spasms general, with or without loss of consciousness.

PAROXYSM.—Onset sudden: often preceded by tingling. Duration: few minutes to hours, or longer in adults. Relaxation gradual. Persist in sleep. Painful in severe cases.

2. **Increased Irritability of Neuro-muscular System.**—Also present between spasms:—

- a. **CHVOSTEK'S SIGN.**—Mechanical irritability of muscles and nerves. A tap over trunk of facial nerve causes muscular contractions.
- b. **ERB'S SIGN.**—Increased irritability to electric current, both faradic and galvanic, especially in ulnar nerve. An anodal opening tetanus may occur.
- c. **TROUSSEAU'S SIGN.**—In interval between paroxysms, a spasm is induced by compression of limb or pressure on nerve trunks.

3. Lesions of Ectodermal Tissues.—Rare. In chronic cases only. (a) Cataract. (b) Opacities in lens (slit-lamp). (c) Loss of hair. (d) Brittleness and ridging of nails. (e) Defects in enamel of teeth.

Latent Tetany.—Signs of increased neuro-muscular irritability, e.g., Chvostek and Trousseau, may be present without spasms. May be twitching of muscles or complaints of tingling, pains, or cramps. This 'latent tetany', a mild or chronic degree, may be converted to 'active' by alkalis, diarrhoea, pregnancy, lactation, or other causes.

DIAGNOSIS.

Usually simple. Estimate serum calcium if suspected. From :—

Tetanus.—Tetany is distinguished by: (1) Onset in hands and feet; (2) Posture in spasm; (3) Etiological factor.

Hysterical Contractions.—Generally unilateral. Electrical irritability not increased.

Strychnine Poisoning.—Complete relaxation between spasms.

PROGNOSIS.

Depends on associated condition.

Infants.—Serious if debilitated, if diarrhoea severe, or spasms widespread.

Adults.—Mortality high with dilatation of stomach.

TREATMENT.

Varies in different forms (*see under* PRINCIPAL TYPES). 'Active' and 'latent' tetany may need different treatment. General considerations :—

1. Acidosis.—Note :—

a. Active tetany of any type tends to disappear on production of acidosis—e.g., gastro-enteritis causing acidosis temporarily stops tetany in rickets.

b. Production of acidosis: By administration of inorganic acid or certain salts of inorganic acids in sufficient amount. Calcium chloride most effective: only a portion of calcium is absorbed from bowel, and excess of chloride radicle absorbed has acid effect; action is not due to calcium, and calcium lactate is useless at this stage. Ammonium chloride also effective.

c. Acidosis thus produced only continues while the drugs are being given: other further treatment necessary.

2. Parathormone.—In hypoparathyroidism, and in acute tetany with hypocalcæmia. Only acts on injection.

3. Calcium Lactate.—To supply calcium deficiency.

4. Vitamin D.

5. Sedatives.—Often necessary. Chloral hydrate: gr. v to x for adult; gr. iiij to v in enema for children.

6. Constipation.—Enema or colonic washes.

IV. CALCIUM AND PHOSPHORUS METABOLISM, NORMAL AND ABNORMAL.

Calcium Metabolism: General Consideration.— PRINCIPAL FUNCTIONS OF CALCIUM.—

1. Formation of bone. Errors of calcium metabolism produce: (a) Rickets and osteomalacia; (b) Osteoporosis; (c) Generalized osteitis fibrosa.
2. Control of irritability of muscle and nerve.
3. Factor in coagulation of blood.

CALCIUM IN DIET.—

RICH IN CALCIUM.—Milk, cheese, butter, eggs, green vegetables, nuts. Oranges: rich in calcium but no vitamin D.

POOR IN CALCIUM.—Seeds, roots, and tubers.

AMOUNT NEEDED IN DIET.—0.4 to 1 gm. daily (adult).

Of calcium ingested, portion is converted by digestive juices into insoluble carbonates, and excreted unabsorbed.

Calcium salts administered by mouth are absorbed with difficulty: aided by lactose.

CALCIUM IN BLOOD.—

Serum calcium contains 9 to 11 mgm. per cent (blood-cells contain no calcium).

CALCIUM EXCRETION—On normal diet about 0.4 to 1 gm. daily.

1. **IN FÆCES.**—(a) Endogenous: mainly controlled by vitamin D. (b) Exogenous: unabsorbed from diet. Total 0.4 gm. daily.
2. **IN URINE.**—Varies mainly with amount of blood calcium. About 0.5 gm. daily.

Storage of Calcium and Phosphorus in the Body.—Are stored in spongiosa of bone under influence of vitamin D, whence they are supplied as needed to the blood for use of tissues under influence of parathormone. Such storage is independent, partly or entirely, of function of bone formation and presence in corticalis of bone.

Phosphorus Metabolism: General Consideration.—

FUNCTIONS OF PHOSPHORUS.—

1. Essential to deposition of true bone.
2. Concerned in contraction of muscle.
3. Concerned in acid-base equilibrium.
4. Concerned in storage and utilization of carbohydrates.

CONNECTION BETWEEN PHOSPHORUS AND CALCIUM METABOLISM.—A reciprocal relationship between amounts of calcium and inorganic phosphorus in the blood is often found. Phosphorus possibly controls calcium.

PHOSPHORUS IN DIET.—Ingested as: nucleoprotein in meat, phosphoprotein in milk, lecithin in egg yolk and liver, and inorganic phosphates.

PHOSPHORUS IN BLOOD.—(1) Organic compounds; esters and lipins. (2) Inorganic compounds; less than one-twelfth of total: equal amounts in plasma and corpuscles.

PLASMA PHOSPHORUS, INORGANIC.—In adults, 2.5 to 3.5 mgm. per cent; in children (growing bone) up to 5 mgm. per cent.

Summary of Principal Factors Controlling Calcium and Phosphorus Metabolism.—

1. **INTAKE.**—Amount in diet of (a) calcium and phosphorus, (b) vitamin D.
2. **ABSORPTION FROM INTESTINE.**—Controlled (a) primarily by vitamin D, (b) by acidosis and alkalosis, (c) by phosphatase, (d) by condition of intestine.
3. **DEPOSITION AND STORAGE IN SPONGIOSA OF BONE.**—Controlled primarily by vitamin D.
4. **SUPPLY FROM SPONGIOSA TO THE BLOOD IN ACCORDANCE WITH NEEDS OF THE BODY.**—Controlled primarily by parathormone. Also by thyroid secretion.
5. **IONIZATION OF CIRCULATING CALCIUM.**—Diminished by alkalosis.
6. **EXCRETION IN FÆCES.**—Controlled primarily by vitamin D (deficiency increases excretion). Also by thyroid secretion.
7. **EXCRETION IN URINE.**—Varies directly with amount of calcium in blood. Also increased in: renal rickets, chronic nephritis, hyperthyroidism.
8. **APPOSITION (DEPOSITION) IN FORMATION OF TRUE BONE FROM OSTEOID TISSUE.**—Depends on amount of calcium and phosphorus in blood. Also on phosphatase.

Dietetic Deficiency in Calcium and Phosphorus.—Usually also associated with deficiency of vitamin D. Necessarily results in hypocalcæmia.

MANIFESTATIONS.—Skeletal rarefaction, e.g., osteoporosis; rarely tetany. Pregnant women specially liable; infants of such mothers also deficient in calcium and prone to infantile tetany.

Vitamin D.—Operates normally to secure most economical use of supply of calcium (and phosphorus) in the diet, and after absorption in the body.

MODE OF ACTION.—(1) Probably controls and limits *excretion* of calcium and phosphorus in fæces (no direct action in urinary excretion); (2) May aid absorption from bowel; (3) Influences for storage purposes deposition of calcium and phosphorus in spongiosa of bone. Action on bone formation: uncertain, but can influence by above methods amounts and deposition of calcium and phosphorus, either by deficiency of vitamin (development of rickets and osteomalacia), or by excess of vitamin. Control on amount of serum calcium and phosphorus uncertain (probably parathormone). No evidence of influence on utilization of calcium by the tissues.

DEFICIENCY OF VITAMIN D.—Results in: (1) Hypocalcæmia; phosphorus in blood also falls. (2) Increased excretion of calcium in fæces, even on calcium-poor diet. No change in urinary calcium.

MANIFESTATIONS (ascribable to hypocalcæmia).—Rickets, osteomalacia, osteoporosis, dental caries, tetany. Also 'hunger osteopathy'.

Note.—In rickets, serum calcium may be normal.

EXCESS OF VITAMIN D.—(Experimental hypervitaminosis D. Enormous doses employed.) *Initial action:* (1) Diminished

Calcium and Phosphorus Metabolism—Excess of Vitamin D, *continued*. excretion of calcium; (2) Diminished storage in spongiosa; (3) Increased absorption from bowels. Whence: hypercalcaemia causing 'metastatic calcification', increased density at growing end of bone and in teeth, and later rise in urinary calcium.

WASTING AND DIARRHŒA.—Direct toxic action of irradiated ergosterol.

Parathyroid Gland Secretion ('Parathormone').—Controls requisite supply to the blood from storage in spongiosa of bone.

HYPOPARATHYROIDISM.—Results in: (1) Hypocalcaemia: plasma phosphorus high. (2) Retention of calcium and phosphorus in the spongiosa.

OCCURRENCE.—(a) Parathyroidectomy. (b) Spontaneous (cf. myxoedema); very rare.

EXCRETION OF CALCIUM.—Low in urine and high in fæces.

MANIFESTATIONS.—Tetany. Occasionally cataract, brittle nails, defects of dental enamel.

HYPERPARATHYROIDISM.—Results in: (1) Depletion of stored skeletal calcium and phosphorus. (2) Hypercalcaemia.

MANIFESTATIONS.—Generalized osteitis fibrosa; metastatic calcification.

Acidosis and Alkalosis.—Degree of influence and mode of action uncertain. Calcium probably absorbed only in acid or neutral medium. Influences:—

1. **IN INTESTINAL CANAL.**—Acid reaction in small intestine converts insoluble calcium phosphate, carbonate, and soaps, into soluble calcium salts, and aids absorption. Alkaline reaction presumably has reverse effect.

2. **IN BLOOD.**—Of total serum calcium (10 mgm. per cent) about 60 per cent is non-diffusible and 40 per cent diffusible and active (ionized). Plasma CO_2 can convert relatively insoluble acid calcium phosphate into more soluble calcium bicarbonate and CaHPO_4 , thus increasing active portion. Alkalosis impedes the ionization. May account for occasional tetany without fall of serum calcium (ionization impeded by alkalosis), and, *per contra*, absence of tetany with low serum calcium (ionization aided by acidosis).

OCCURRENCE OF ALKALOSIS.—In: (a) Overdosage with alkalis; (b) Intestinal disease involving loss of chloride—e.g., excessive vomiting in pyloric stenosis, gastric atony; especially with frequent lavage; (c) Hyperpnœa—washes out CO_2 from plasma; (d) Effect of pyrexia.

Note.—Also affects circulating calcium. (See also TETANY, p. 889.)

MANIFESTATIONS OF ALKALOSIS.—Tetany.

Phosphatases.—Action little understood. Are enzymes. Widely distributed. (1) Cause deposition of calcium phosphate in bone, thus converting osteoid tissue into true bone. Act by hydrolysing esters into phosphates, thus exceeding limit of soluble calcium phosphate and causing deposition. (2) In intestinal juices hydrolyse phosphoric esters of food to soluble calcium salts which can be absorbed.

PLASMA PHOSPHATASE AND BONE DISEASES.—Great increase of phosphatase in certain generalized bone conditions—viz., rickets, renal rickets, osteitis deformans, generalized osteitis fibrosa, secondary carcinomatosis. Variable in hyperthyroidism, osteogenesis imperfecta. Normal in focal osteitis fibrosa.

Thyroid Gland: Thyroxin.—Action remarkable.

HYPERTHYROIDISM (either Graves' disease or due to thyroxin injections).—Results in:—

1. Increased excretion of calcium and phosphorus both in urine and faeces.

2. Calcium and phosphorus in blood unchanged.

RESULT ON BONES.—*Osteoporosis*. Due entirely to excessive osteoclastic lacunar absorption; no cessation of deposition of calcium salts (as occurs in rickets).

AFTER IODINE ADMINISTRATION OR THYROIDECTOMY.—Excretion returns towards normal.

MYXŒDEMA.—Calcium excretion diminished.

IN PARATHYROID TETANY.—Thyroid by mouth or thyroxin increases serum calcium: thus influences cure. Increase lasts six weeks.

Note.—Thyroid increases blood calcium when deficient, but not when normal.

MODE OF ACTION OF THYROID.—Apparently acts on bones (cf. parathyroid), causing output of calcium into circulation: hypercalcaemia prevented by increased excretion.

CALCIUM AND PHOSPHORUS METABOLISM IN DISEASE.

DISEASE	BLOOD		CALCIUM EXCRETION		PHOSPHATASE
	Calcium (serum)	Phosphorus (plasma, inorganic)	Urine	Faeces	
Hypocalcaemia	—	±	—	Nil	
Hypercalcaemia	+	—	+	Nil	
Hypovitaminosis D ..	—	—	—	+	
Hypervitaminosis D ..	+	+	+	—	
Hypoparathyroidism ..	—	+	—	Nil	
Hyperparathyroidism ..	+	—	+	Nil	
Rickets	Normal	—	Normal	+	+
Osteomalacia	—	—	—	+	+
Coeliac disease and rickets	—	—	—	+	
Sprue	Normal	—	—	+	
Tetany, post-operative ..	—	+	—	Normal	
" coeliac	—	—	—	+	
" gastric	Normal	+	—	+	
Hyperthyroidism	Normal	Normal	+	+	±
Renal rickets	—	+	+	Normal	+
Generalized osteitis fibrosa	+	—	+	+	+
Multiple myelomatosis ..	+	+	+	Normal	
Local osteitis fibrosa ..	Normal	Normal	Normal		Normal
Osteitis deformans	Normal	Normal			++
Osteogenesis imperfecta ..	Normal	Normal	Normal	Normal	±

Calcium and Phosphorus Metabolism, *continued*.**Hypocalcæmia.**—**SPECIAL CHARACTERISTICS.**—

1. **CHANGES IN BONES.**—Hypocalcæmia is associated with deficient deposition in or withdrawal from bones of calcium and phosphorus, resulting in rickets, osteomalacia, osteoporosis, hunger osteopathy.
2. **TETANY.**—Deficient serum calcium cannot control irritability of muscles and nerves.

OCCURRENCE.—Occurs in following conditions:—

1. **DEFICIENCY OF VITAMIN D IN DIET.**
2. **HYPOPARATHYROIDISM.**
3. **DEFICIENCY OF CALCIUM AND PHOSPHORUS IN DIET.**
4. **ALKALOSIS.**—

Manifestation.—Tetany.

5. **GASTRO-INTESTINAL DISTURBANCES CAUSING ALKALOSIS.**—Excessive vomiting, e.g., in pyloric stenosis; also gastric atony, especially with frequent lavage. Loss of chlorides produces alkalosis.

Manifestation.—Tetany.

6. **CÆLIAC DISEASE AND IDIOPATHIC STEATORRHEA.**—

Cause of Hypocalcæmia.—Deficient absorption of vitamin D. Formation of insoluble calcium soaps with excess of unabsorbed fatty acids of little importance.

Plasma Phosphorus.—Low.

Excretion of Calcium.—In fæces, high; urine, low.

Note.—Only a small proportion of this group exhibits hypocalcæmia and its sequelæ. In sprue hypocalcæmia is unusual.

7. **RENAL RICKETS.**—Hypocalcæmia only occurs in late stages of some cases of RENAL INFANTILISM (*see* p. 663), and in these rickets develops and tetany is common.

Cause of Hypocalcæmia.—Uncertain. Plasma phosphorus rises with blood-urea. Urinary calcium then increases and serum calcium falls. Not due to deficiency of vitamin D. Probably disturbance of endogenous metabolism from nephritis.

Plasma Phosphorus.—High.

Bones.—Diminution of calcium and phosphorus.

Calcium Excretion.—Fæces, normal; urine, markedly high.

Manifestations.—Osteoporosis, rickets. Tetany.

Hypercalcæmia.—Is result of abnormal processes rather than the cause. Excess of blood calcium tends to result in 'metastatic calcification' and in urinary calculi.

OCCURRENCE.—In following conditions:—

1. **HYPERVITAMINOSIS D.**—*See* p. 893.
2. **HYPERPARATHYROIDISM.**—With: (a) Parathyroid tumour; (b) Excessive injections of parathormone (no acute effects in man).

3. **DESTRUCTION OF BONE.**—In multiple myelomatosis, calcium and phosphorus may rise in blood, with 'metastatic calcification' and urinary calculi. Ascribed to destruction of deposits in bone.

'*Metastatic Calcification*'.—Widespread deposition of calcium in arteries (including aorta, coronary), heart muscle, stomach wall, lungs, kidneys, intercostal muscles. Deposits are in healthy cells.

CHAPTER CLXI.

DISEASES OF THE PITUITARY BODY.

I. MORPHOLOGY AND FUNCTIONS OF THE PITUITARY BODY.

Morphology.—Lies in the sella turcica, attached by the infundibulum to the base of the brain behind the optic chiasma. Weight in adults about 0.5 grm. Size: transverse diameter 12 to 15 mm.; vertical and antero-posterior diameters 5 to 8 mm. Divides at intraglandular cleft into two lobes.

ANTERIOR LOBE.—Envelops posterior lobe laterally and forms two-thirds of body.

HISTOLOGY.—Columns of epithelial cells with numerous blood-sinuses and blood-vessels. Three types of cells: (1) Chromophil, large cells containing granules: (a) eosinophil or acidophil; (b) basophil, less numerous and mainly at periphery of lobe. (2) Chromophobe, small clear neutrophil cells. These cells are probably fixed in type, as each variety can produce adenomata.

POSTERIOR LOBE.—Consists of three parts,.

HISTOLOGY.—

- a. *Pars Intermedia.*—A narrow lining on the posterior wall of the cleft consisting of polygonal neutrophil cells. 'Hyaline bodies' present, probably a secretion formed by degeneration of the cells. Also sometimes definite colloid (contains no iodine). Blood-vessels not numerous.
- b. *Pars Nervosa.*—Mainly neuroglia: no true nerve-cells or fibres, and no evidence of formation of secretion. 'Hyaline bodies' present, in passage from pars intermedia to cavity of 3rd ventricle: numerous after thyroidectomy. Blood-vessels scanty.
- c. *Pars Tuberalis.*—Formed by two lateral processes budded off from Rathke's pouch, which grow upwards along infundibulum: function unknown.

INFUNDIBULUM.—Stalk connecting glands to floor of 3rd ventricle and hypothalamus.

The Pituitary Body, *continued*.

Development.—Two separate embryonic tissues contribute.

1. A process develops from the cerebral vesicle, the thalamencephalon, finally forming the *pars nervosa* and infundibulum: in the latter a cavity connecting with the 3rd ventricle persists in certain animals. This unites with:—
2. Rathke's pouch, an outgrowth from the primitive buccal cavity or stomodæum. Early in 4th week, the neck is constricted by growth of the sphenoid cartilage. The cavity persists as the intraglandular cleft, the posterior wall forming the *pars intermedia*, this portion of the posterior lobe thus having same origin as the anterior lobe.

FUNCTIONS AND INTER-RELATIONS WITH OTHER ENDOCRINE GLANDS

It is now believed that pituitary has initial direction and control of other endocrine glands. Certain relations with sexual glands, thyroid, and adrenals are here referred to. Also has relations with thymus and parathyroids. Knowledge incomplete, rapidly advancing, and views constantly changing. Evidence obtained by: (1) Administration of gland extracts; (2) Experimental removal; (3) Correlation of clinical syndromes with pathological changes.

Anterior Lobe.—Secretion is absorbed into circulation.

ADMINISTRATION, BY MOUTH OR INJECTION.—No definite effects in man. In animals: can neutralize effects of hypophysectomy; produces gigantism; produces metamorphosis in tadpoles (probably by action on thyroid; by transplantation causes precocious sexual development in rats.

EXPERIMENTAL REMOVAL.—Tends to produce: (a) Genital infantilism; (b) Partial stunting of growth. Effects neutralized by transplantation or injection of anterior lobe. Adiposity common, probably due to posterior lobe injury. Syndrome resembling Simmonds' disease produced in rats by P. E. Smith.

CLINICAL OBSERVATIONS.—Based mainly on effects of adenomata.

a. **CHROMOPHOBIC CELLS.**—Produce no hormone.

b. **EOSINOPHIL CELLS.**—'Growth-provoking' hormone: skeleton, skin, and soft tissues.

c. **BASOPHIL CELLS.**—'Sex-maturing' hormone.

REMOVAL OF WHOLE GLAND.—Causes inhibition of growth and sex. Absence of anterior-lobe growth hormone overrides posterior-lobe obesity factor.

ANTERIOR PITUITARY HORMONES.—The following are the chief hormones at present recognized (none yet isolated):—

1. **GROWTH-PROVOKING HORMONE.**—From *acidophil* cells. Influences skeleton, and all tissue. Action exemplified by gigantism and acromegaly.
2. **GONADOTROPIC, 'SEX-MATURING', HORMONES.**—Prolan A and B. From *basophil* cells. (See p. 899.)

3. **THYROTROPIC HORMONE.**—Believed to stimulate thyroid to produce thyroxin. Note:—

- a. Thyroid atrophies, if pituitary is removed or destroyed.
- b. In endemic goitre or after thyroidectomy, anterior pituitary hypertrophies.
- c. Thyroid hyperplasia and thyrotoxicosis can be produced by injection of anterior pituitary. Effect lasts two weeks only: cause unknown.

Exophthalmos in Thyrotoxicosis.—Ascribed to excess of thyrotropic hormone and not primarily of thyroxin. Is produced experimentally most easily in hypothyroidism: absence in myxœdema ascribed to simultaneous deficiency of the hormone. (Factors still obscure. Adrenalin can provoke exophthalmos.)

4. **DIAHETOGENIC HORMONE.**—(1) Hyperactivity of lobe is associated with lowered carbohydrate tolerance and glycosuria: latter often intermittent, varies apart from carbohydrate intake, but coma may occur (pituitary glycosuria) (2) Hypo-activity is associated with increased carbohydrate tolerance. Action of hormone is contrary to insulin. If an animal's pituitary is removed, subsequent removal of the pancreas does not produce diabetes

5. **ADRENOTROPIC HORMONE.**—Close relationship exists between pituitary and adrenal cortex. For Cushing's syndrome, see p. 906. Note: (1) Atrophy of cortex is present in Simmonds' disease and develops after hypophysectomy; (2) Hypertrophy of cortex is present in acromegaly; (3) In Addison's disease, basophil cells in pituitary are diminished.

6. **LACTOGENIC HORMONE**—The breast is stimulated to lactate by œstrin; subsequently lactation is maintained by anterior pituitary hormone (prolactin).

ANTERIOR PITUITARY AND SEX HORMONES —

MENSTRUATION AND PREGNANCY.—Relationships may be stated provisionally as follows:—

1. *Prolan A* (anterior pituitary gonadotropic hormone) — Stimulates ovarian function, causing maturation of Graafian follicle in ovary
2. *œstrin* (theelin) — Liberated by mature follicle (is a sterol). Excites œstrus and hyperplasia of uterine mucosa. Appears in urine in pregnancy.
3. *Prolan B* (anterior pituitary-like hormone).—Protein compound. Causes luteinization of Graafian follicle. Present in urine during pregnancy, disappears immediately after labour; present in large amount with hydatidiform mole. (Also known as antuitrin S.)
4. *Progesterin*.—Produced by corpus luteum (is a sterol). (i) Prepares uterine mucosa for ovum, maintains it if ovum fertilized; (ii) Controls formation of placenta; (iii) Neutralizes oxytocin, thus inhibiting menstruation

Anterior Pituitary and Sex Hormones, continued.

in pregnancy. *Menstruation* develops and also *pregnancy* ends when *progestin* ceases and thus *oxytocin* exercises its stimulus of contraction of the uterus.

Note.—Some authorities believe that there is only one *prolan* hormone. Others believe that *prolan B* is produced by the placenta.

Aschheim-Zondek Pregnancy Test.—Based on presence in urine of pregnancy of *prolan*, which produces hæmorrhagic follicles (blood-spots) in ovary of sexually immature female mouse. Positive in first week after first missed period.

Friedman's test.—Similarly applied to rabbits.

Clinical Use of Injections of Œstrin.—(1) At menopause—relieves mental and vasomotor disturbances; (2) Menstrual irregularities.

Production of Menstruation in Amenorrhœa—Kaufmann's therapy: Course of *œstrin* covering about 2 weeks followed by course of *progestin*: menstruation occurs on stopping *progestin*. Large doses must be used and Kaufmann's system followed exactly. If uterus infantile, prolonged initial course of *œstrin* injections. *Scheme:* (1) *Œstrin* preparation, e.g., *progynon B oleosum* (Schering), 200,000 international units, on 1st, 4th, 8th, 12th, and 16th days after calculated end of menstrual period (by any suggestive symptom); (2) *Lutein* hormone, e.g., *progestin*, 40 units on 19th to 23rd day, 40 units daily. Menstruation anticipated on 27th or 28th day.

UNDESCENDED TESTIS.—Testis is immature. *Prolan* injections activate interstitial cells of testis, which develops and descends.

ANDROSTERON.—Male sexual hormone. Present in urine. Produces comb growth in capons. Chemically allied to *œstrin*.

Posterior Lobe.—Secretion passes along stalk into brain and hence into cerebrospinal fluid. Secretion generally known as *pituitrin*. Probably produced by hyaline cells of *pars intermedia*: these cells pass through *pars nervosa* and *pars tuberalis* (which produce no secretion), and through stalk to diencephalon. Only effective on injection (possibly also by nasal absorption). No recognizable change follows removal of posterior lobe.

POSTERIOR PITUITARY HORMONES.—Two independent hormones:—

1. **OXYTOCIN (PITOCIN).**—Stimulates uterus to contract, and thus induces menstruation and terminates pregnancy. Is neutralized by *progestin*.
2. **VASOPRESSIN (PITRESSIN).**—Certain results recognizable after injection (also on nasal absorption).

No clinical effects follow removal of posterior lobe. Apparently co-operates with hypothalamus, and manifestations follow injury to latter structure.

MAIN ACTIONS OF VASOPRESSIN.—

1. RAISES BLOOD-PRESSURE.—Heart is slowed and beats are more powerful.

Note: Extracts may contain depressor substance, produced in manufacture, causing preliminary fall in pressure and collapse: hence dangerous as cardiac stimulant: if collapse occurs, injection should not be repeated under 3 hours, as further depressor action continues for this period.

2. WATER METABOLISM.—Inhibits normal diuresis after drinking large quantities of water.
3. STIMULATES CONTRACTION OF INVOLUNTARY MUSCLE.—Intestines, bronchial, etc.
4. CARBOHYDRATE METABOLISM.—Action complex. Antagonizes insulin; and also adrenalin.
5. CONTROL OF PIGMENT FORMATION.—In cold-blooded animals.
6. GASTRIC ULCERATION.—Injections in large quantities produce gastric ulcer. Frequency of gastric ulcer after removal of hypophysis has been noted.

HYPOTHALAMIC - POSTERIOR - PITUITARY ASSOCIATED FUNCTIONS.—Manifestations clinically only with damage to hypothalamic nuclei, e.g., by suprasellar tumour, trauma, encephalitis. Not produced solely by complete destruction of posterior lobe (which forms the hormone). Mechanism not understood.

1. DIABETES INSIPIDUS. CONTROL OF WATER METABOLISM (*see p 909*).—Posterior pituitary hormone enables kidney to secrete a concentrated urine.
2. OBESITY.—Normal action on liver, promoting consumption of fat, obesity developing in absence. Affects basal metabolic rate. Action still obscure.
3. SLEEP.—Control probably under hypothalamus alone.

II. SYMPTOMATOLOGY OF DISEASES OF THE PITUITARY BODY.

A. Neighbourhood Symptoms.—Due to local pressure effects: occur with tumours or hyperplasia.

1. HEADACHE.—Bitemporal Possibly distension of capsule.
2. OCULAR MANIFESTATIONS.—From pressure on optic chiasma and tracts. Especially in suprapituitary lesions.
 - a. PRIMARY OPTIC ATROPHY.—Not uncommon, usually unilateral: 'choked disc' may occur on other side.
 - b. ALTERATIONS IN THE VISUAL FIELDS.—Usually asymmetrical. May commence as:—
 - i. *Bitemporal hemianopia*.—Classical type, but not very frequent. Begins in upper margins.
 - ii. *Loss of colour vision* (red initially).—Often very early: may begin as central scotoma, or peripherally, or both together.
 - iii. *Central scotoma*.—Extends to form temporal hemianopia.

Pituitary Body—Symptomatology of Diseases of, continued.

iv. *Unilateral blindness*.—Opposite side subsequently.

v. *Homonymous hemianopia*.—Occurs occasionally. Blindness finally may be complete.

c. **OCULAR PALSIES**.—Not common. From pressure on 3rd, 4th, and 6th nerves in cavernous sinus.

3 **CHANGES IN SELLA TURCICA**.—(a) Thickening of clinoid processes. Only as part of bony overgrowth in acromegaly and gigantism. (b) Thinning of clinoid processes and enlargement of sella. With adenomata. (c) Destruction of outlines. Usually malignant tumours. (d) Sella abnormally small. Primary hypoplasia. (e) Sella normal. In tumours of pituitary stalk.

4. **PRESSURE ON THE BRAIN**.—Sites: (a) Hippocampus gyrus, producing uncinat fits: not uncommon. (b) Frontal lobes, rarely: psychical changes.

5. **NASOPHARYNGEAL SYMPTOMS**.—Epistaxis; discharge of mucus or of cerebrospinal fluid. Occasionally, in malignant tumours.

Rarely: Exophthalmos: from pressure on cavernous sinus or effect of thyrotropic hormone. Trigeminal neuralgia. Distension of veins of scalp and eyelid.

B. **General Pressure Effects**.—From rise of intracranial pressure. Rarely marked, except headache. Vomiting and choked disc are both unusual. Commonest in suprapituitary lesions in children.

C. **Secretory or Glandular Symptoms Proper**.—Manifestations complicated by the following factors: (1) Either lobe may be over- or underactive, and overactivity of one may be associated with underactivity of the other; (2) Overactivity may be followed by underactivity—e.g., acidophil cells may be destroyed by increasing chromophobe adenoma; (3) Effects vary with age at onset.

D. **Polyglandular Syndromes**.—The general control of pituitary over other endocrine glands causes mutual changes following disorders of any gland and produces complicated syndromes (see p. 898). For example: (1) Sexual organs: pituitary enlarges in pregnancy and after castration (overgrowth and adiposity in eunuchs). (2) Thyroid: myxedema common with acromegaly; pituitary enlarged and active after thyroidectomy, and in myxedema, goitre, and cretinism; and inactive in hyperthyroidism. (3) Suprarenals: hyperplasia marked in basophil adenoma of pituitary.

E. **Hypothalamus**.—Close connection involving psychical and other manifestations, e.g., 'sham rage'. Little understood. (See also p. 901.)

F. Summary of Pituitary Syndromes.—Provisional classification.—**ANTERIOR LOBE.**—

1. **CHROMOPHOBE CELLS.**—No hormone. Principal lesion: chromophobe adenoma. Effects very variable. Due to: (a) Various local pressure effects, e.g., headache, loss of vision (often not definitely localizing); (b) Interference with eosinophil and basophil cells and posterior lobe, producing various hypopituitary manifestations (and hyperpituitary), e.g., Fröhlich's syndrome.

Pituitary Tabes.—Optic atrophy, leg pains, absent knee-jerks, but pupils react to light.

2. **EOSINOPHIL CELLS.**—Growth-provoking hormone.
 - a. *Over-secretion (Hyperpituitarism).*—Principal lesion: eosinophil adenoma. (i) Gigantism: before union of epiphyses. (ii) Acromegaly: after union of epiphyses. (iii) Hemihypertrophy: in children.
 - b. *Under-secretion (Hypopituitarism).*—Principal lesion: atrophy of whole lobe. (i) Ateleiosis, dwarfism: congenital hypoplasia. (ii) Simmonds' syndrome: primary atrophy or acquired, e.g., embolic. (iii) Progeria (doubtful).
3. **BASOPHIL CELLS.**—Sex-maturing hormone.
 - a. *Over-secretion.*—Principal lesion: basophil adenoma. Cushing's syndrome.
 - b. *Under-secretion.*—See EOSINOPHIL CELLS.

POSTERIOR LOBE—Requires further elucidation clinically.

- a. *Over-secretion.*—May result from pituitary tumours, or basal meningitis. Manifestation: 'pituitary glycosuria'.
- b. *Under-secretion.*—Various lesions interfering with hypothalamus: tumours, trauma, meningitis, encephalitis. Manifestations: Some cases of (i) diabetes insipidus, (ii) obesity, (iii) possibly subinvolution of uterus.

WHOLE GLAND.—

Under-secretion.—Syndromes of adiposity, genital dystrophy or atrophy, stunting of growth and infantilism, varying in type principally according to age at onset: (i) Before puberty: 'padding-face type' (Fearnside). (ii) During puberty: dystrophia adiposo-genitalis (Fröhlich). (iii) After puberty: eunuchoidal types.

SUPRASELLAR LESIONS (see p. 908).—General resemblance to chromophobe adenoma, but: (1) May occur in children; (2) Pressure on chiasma common.

HYPERPITUITARISM.—Principal syndromes are thus:—

1. **ANTERIOR LOBE.**—(a) Acromegaly, gigantism, hemihypertrophy; (b) Cushing's syndrome.
2. **POSTERIOR LOBE.**—Pituitary glycosuria.

HYPOPITUITARISM.—Principal syndromes:—

1. **ANTERIOR LOBE.**—Ateleiosis, Simmonds' disease, progeria.
2. **POSTERIOR LOBE.**—Diabetes insipidus, some forms of obesity.
3. **WHOLE LOBE.**—Group of sexual infantilism combined with obesity (classified as Fröhlich's syndrome).

III. ACROMEGALY:

A condition characterized clinically by excessive growth of certain portions of the skeleton, especially exhibited in the face and extremities, by overgrowth of the soft tissues, and, pathologically, by an eosinophil adenoma of the anterior lobe of the pituitary, causing hypersecretion.

Eosinophil Hyperpituitarism of the Anterior Lobe.—Produces skeletal overgrowth, resulting in: (1) Gigantism, if occurring previous to ossification of epiphyses. (2) Acromegaly, if subsequent to such ossification: in the latter event, the skeletal overgrowth is in the acral portions, i.e., periosteal, though not entirely, since the lower jaw increases in length. (3) A pituitary giant may become acromegalic, since the hypersecretion may subside and then recur, ossification of epiphyses occurring in the interval. (4) Hemihypertrophy in infancy: one side or one leg; may disappear later. Minor grades of this hyperpituitarism are probably common.

In *acromegaly* two stages may be recognizable, hyposecretion and its phenomena superseding the hypersecretion. Other tissues of pituitary may be affected by pressure, becoming under- or over-active.

Etiology.—

AGE AT ONSET.—Commonest in third decade.

SEX.—Females 60 per cent.

PREDISPOSING CAUSES.—Unknown. Hereditary factor.

Pathology.—

1. PITUITARY BODY.—Adenoma of eosinophil cells of anterior lobe: simple or fibrous: never sarcoma. Remainder of gland may be affected by pressure.
2. SKELETAL CHANGES.—Overgrowth of bone at bony prominences and sites of stress, e.g., origin and insertion of muscles, 'the osteoblasts being hypersensitive to ordinary stresses' (Keith).
3. SOFT TISSUES.—Thickening of skin and subcutaneous tissues (principal cause of large hands and feet).

OTHER DUCTLESS GLANDS.—Thyroid rarely normal: atrophic, enlarged, or goitrous. Various changes described in other glands.

Symptoms.—

COMMON EARLY COMPLAINTS.—(a) Increase of size in features, hats, gloves, and boots; (b) Visual changes; (c) Headache; (d) Tingling or numbness of hands or feet.

The varied symptoms described under SYMPTOMATOLOGY, p. 901, may occur. Note especially hemianopia and the ocular manifestations. General pressure-effects rare. May be previous gigantism.

SYMPTOMS DUE TO ALTERATIONS OF SECRETION.—

- a. SKELETAL CHANGES AND INCREASE IN SIZE.—

Face elongated and enlarged.—Especially lower jaw: teeth may protrude 1 inch beyond upper. Also superior maxilla, zygoma, and other prominences. Head in general enlarged.

Hands and feet enlarged.—Uniformly (from subcutaneous tissue increase and exostoses at tendon attachments). Arms rarely affected. Fingers not 'clubbed'.

Soft tissues increased.—Nose, eyelids, tongue, and especially ears. Skin thick.

Kyphosis and lordosis. *Thorax* increased in size: respiratory expansion slight. Sternum and clavicles enlarged.

Use of limbs not affected by changes.

b. CARBOHYDRATE METABOLISM (if posterior lobe involved).—

In early stage: glycosuria and hyperglycæmia. Later stage: hypoglycæmia and high carbohydrate tolerance.

VARIOUS AND OCCASIONAL SYMPTOMS.—(1) Early stage: (a) Libido; (b) Physical strength. (2) Late stage: (a) Impotence or amenorrhœa; (b) Physical and cardiac weakness.

POLYGLANDULAR SYNDROMES.—Goitre and changes in other ductless glands: e.g., combined myxœdema and acromegaly occur occasionally.

RADIOGRAPHS.—Note especially:—

1. **SELLA TURCICA.**—May be: (a) Thickening of clinoid processes: a part of the general bony overgrowth. (b) Thinning of clinoid processes and enlargement of sella. Sella is never under the average dimensions.

2. **HANDS AND FEET.**—The terminal phalanges have characteristic 'tufts'.

Diagnosis.—Difficult in early stages. X-ray of sella turcica and cranium of great value (when perfect). Occasional diagnosis from:—

MYXŒDEMA.—Bones unaffected. Dry hair and skin, etc. Effects of thyroid therapy.

OSTEITIS DEFORMANS.—Late age. Tibiæ curved. Lower jaw and soft tissues unaffected.

ARTHRITIS DEFORMANS.—Head not enlarged. Pain. Limited movements.

PULMONARY OSTEO-ARTHROPATHY.—Fingers clubbed. Heart or lung affections.

Course and Prognosis.—

DURATION.—10 to 50 years Progress slow, often intermissions. Headaches tend to diminish.

TERMINATION.—From cerebral tumour; cardiac weakness; very rarely, diabetic coma.

Notes on Gigantism.—Anthropologists consider persons over 6 feet 8 inches as 'giants'. Giants are: (1) Pathological—i.e., hyperpituitarism (40 per cent of all giants). (2) Normal; appearance often suggests acromegaly; usually weak, physically and mentally, and die young, 20 to 30 years.

Treatment.—

ORGANOTHERAPY.—Pituitary treatment unsatisfactory. Thyroid beneficial in myxœdematous types.

X-RAY THERAPY TO SKULL.—Occasional benefit.

OPERATION.—For relief of intracranial pressure and to save sight.

IV. BASOPHIL ADENOMA OF THE PITUITARY.*

(Pituitary Basophilism. Cushing's Syndrome.)

A condition ascribed to hypersecretion of the basophil cells of the anterior lobe of the pituitary, due to presence of an adenoma, and characterized by adiposity, stunted growth, sexual changes, and alteration in hirsuties and skin.

Pathogenesis.—In dispute. Note:—

1. Basophil adenoma present in most cases of the syndrome.
2. Syndrome can occur in hyperplasia of adrenal cortex in absence of basophil adenoma. Also recorded in neoplasm of thymus.
3. Basophil adenoma recorded in absence of symptoms.
4. In hyperplasia of adrenal cortex due to tumour, secondary increase of basophil cells may occur.

Hyalinization of cytoplasm of basophil cells recently stated to be present in all cases. Not yet confirmed fully.

Etiology.—

AGE.—Young adults and adolescents commonest. Onset at 5 to 25 years.

SEX.—More marked in females. Less common or manifestations less developed in males, especially adults.

Morbid Anatomy.—

PITUITARY.—Basophil adenoma in anterior lobe: not larger than pea. Gland may appear of normal size and tumour only be found in sections.

SUPRARENALS.—Hyperplasia of cortex common: may be gross enlargement.

Symptoms.—

STATURE.—Undersized (adult males may be tall).

ADIPOSITY.—Rapidly acquired. May be painful, especially face.

Distribution: Face, neck, trunk; extremities less affected.

OSTEOPOROSIS (Decalcification).—*Kyphosis* usually marked, causing loss of stature. Osteoporosis may be local or general.

SEXUAL CHANGES.—In children (both sexes): premature sexual maturity. In females (puberty and over): amenorrhœa, reversal of secondary sexual characters, i.e., *virilism*. In males: ultimate impotence.

ALTERATION IN HIRSUTIES.—In females and young males: hypertrichosis of face and trunk. Adult males: hair diminished.

SKIN.—Dusky or plethoric; extreme dryness. *Lineæ atrophicæ* extreme: purplish. May be pigmentation. *Lower extremity congested.*

BLOOD-PRESSURE.—Raised.

PAINS.—Lumbo-spinal pains. Fatigue and weakness.

Glycosuria or lowered sugar tolerance.

Less constant: acrocyanosis; purpura-like ecchymoses; œdema of legs.

Diagnosis.—Recognition of syndrome simple.

* See CUSHING, *Bulletin of the Johns Hopkins Hospital*, March, 1932.

V. SIMMONDS' DISEASE.

Pituitary cachexia. Due to destruction of anterior lobe of pituitary by various causes—e.g., emboli, thrombosis, tuberculosis, tumours, cysts, syphilis, and trauma. Secondary atrophic changes in thyroid, parathyroids, suprarenal cortex, and reproductive glands. Does not develop after operative removal of hypophysis.

Onset in Childhood.—General resemblance to Fröhlich's disease, but no tumour symptoms.

TREATMENT.—Injections of anterior lobe extracts.

Onset in Adult Life.—

1. **EXTREME CACHEXIA, EMACIATION, AND WEAKNESS.**—

Low blood-pressure and basal metabolic rate

2. **APPEARANCE OF PREMATURE SENILITY.**—Hair and teeth fall out: skin rough.

3. **INVOLUTION OF SEXUAL ORGANS.**—Amenorrhœa, impotence. Occasionally: psychical changes Sugar tolerance diminished. May die in coma.

Diagnosis.—From Addison's disease: no deep pigmentation; marked rise of pressure on injection of adrenalin.

Progeria.—May belong to this group, but not proved.

VI. DYSTROPHIA ADIPOSO-GENITALIS (Fröhlich).

A group of conditions due to deficient secretion of the pituitary gland (hypopituitarism), and characterized by obesity, arrest of development or alteration of sexual characteristics, and tendency to infantilism.

Hypopituitarism in Relation to Adiposity combined with Infantilism of Growth and Sex.—Adiposity is controlled by hormones of posterior lobe, and growth and sex by hormones of anterior lobe. Syndromes combining both groups are due to lesions involving both lobes. Manifestations vary, depending on: (1) Age at onset—involving degree of growth and sex development already present; (2) The two lobes may be affected in different degrees; (3) Mild grades of all forms are not uncommon.

Morbid Anatomy.—(1) Tumour of pituitary body, e.g., chromophobe adenoma, rarely sarcoma, gumma Occasionally: (2) Primary hypoplasia of gland; (3) Serious effects on gland or the paths of its secretion produced by extrinsic tumours, injuries, encephalitis, or internal hydrocephalus, e.g., from previous meningitis, cerebellar tumours.

Types.—Following can be correlated (approximately) to age of onset:—

1. **ONSET BEFORE PUBERTY.**—Fearnside's 'pudding-face type'. Adiposity enormous and universal. Stature often not less and may be greater than normal. Genital dystrophy not marked. Tumour may cause early death.
2. **ONSET DURING PUBERTY.**—Terms 'dystrophia adiposo-genitalis' and 'Fröhlich's disease' are usually confined to this group.

Dystrophia Adiposo-genitalis—Types, continued.

- a. DEFICIENT GROWTH OF SKELETON.—Insufficient to constitute 'dwarfism'. Bodily proportions: shortening of lower measurements—i.e., symphysis-sole less than symphysis-vertex—from union of epiphyses. In males, tendency to feminine (or neutral) outlines—viz., broad pelvis, genu valgum common, delicate tapering of fingers and fine extremities.
 - b. SEXUAL INFANTILISM.—Sexual organs remain infantile, and secondary sexual characteristics absent—i.e., no hair on face, pubes, or axilla, mammæ small, no menstruation or spermatozoa.
 - c. ADIPOSITY.—General, but specially in feminine sites—e.g., over hips.
3. ONSET AFTER PUBERTY.—
- a. EUNUCHOIDAL TYPE.—Reversion to a 'neutral' type: (i) Atrophy of sexual organs, impotence or amenorrhœa. (ii) Adiposity: in males, specially in feminine sites, with tapering fingers and smooth skin.
 - b. ADIPOSIS DOLOROSA.—See p. 360. Not invariably of pituitary origin.

Notes on Symptoms.—

1. GENERAL FEATURES.—Intelligence normal. Somnolence common. Sugar tolerance increased. Blood-pressure variable.
2. NEIGHBOURHOOD SYMPTOMS.—Occur with tumours (see SYMPTOMATOLOGY OF DISEASES OF THE PITUITARY BODY, p. 901).

Treatment.—See ACROMEGALY, p. 905.

VII. TUMOURS OF THE PITUITARY BODY.**1. Pituitary Tumours.—**

- a. ADENOMA.—(i) Chromophobe; (ii) Eosinophil (acromegaly and gigantism); (iii) Basophil (Cushing's syndrome). See PITUITARY SYNDROMES, p. 903.
- b. SARCOMA. CARCINOMA.—Tend to grow through floor of sella. Various neighbourhood effects; discharge of cerebrospinal fluid through nose.

2. Suprasellar Tumours.—

- a. CYST OF RATHKE'S POUCH.—Unilocular cyst. May be entirely above gland (suprasellar cyst), or involve and distend gland.
- b. TUMOURS OF HYPOPHYSIAL (CRANIO-PHARYNGEAL) DUCT.—This duct is the tube of which the end forms Rathke's pouch: tumours form from cell relics.
MORBID ANATOMY.—(i) Adamantinoma: tumour of enamel organ found in jaw (i.e., a teratoma). Calcification occurs, causing in radiographs slight shadow above sella. Some deformity of sella common. (ii) Cyst (suprasellar cyst). (iii) Intracystic papilloma (rare).

SYMPTOMS.—General resemblance to chromophobe adenoma: endocrine disturbances usual but variable. Special characters: (1) Bitemporal hemianopia common. (2) May occur in children. (3) Obesity and polyuria may develop from compression of hypothalamic nuclei. (4) In children: symptoms of raised intracranial pressure common—e.g., papilloedema. (5) In adults: optic atrophy common. (6) Blood-pressure very low. (7) Operation results very bad.

Note.—Glioma of third ventricle and intrasellar growth extending upwards may have similar effects.

VIII. DIABETES INSIPIDUS.

A rare chronic affection characterized by the persistent passage of large amounts of urine of low specific gravity, and free from sugar and albumin. Due to deficiency of posterior-lobe hormone in association with tuber cinereum. Two groups:—

1. **Primary or Idiopathic Group.**—No organic lesion. Hereditary factor marked: may be through many generations. Usually males. Onset frequently in youth. Slow and insidious.
2. **Secondary or Symptomatic Group.**—Due to lesion diminishing formation of, or obstructing passage into circulation of, secretion of posterior lobe of pituitary: (1) Syphilis, common: basal meningitis involving pituitary. (2) Tumours and similar lesions of pituitary, e.g., leukaemic infiltration. (3) Organic disease of central nervous system affecting circulation of cerebrospinal fluid, e.g., blockage of foramen of Magendie as a sequel of cerebrospinal fever. (4) Trauma. (5) Encephalitis: epidemic, post-vaccinal, etc. (6) Lesions of stalk and tuber cinereum.

ONSET usually gradual: in trauma, onset often sudden and immediate.

Morbid Anatomy.—In primary group, no characteristics: bladder and ureters may be hypertrophied.

Pathogenesis.—Water metabolism is controlled by: (a) Tuber cinereum (nucleus supra-opticus in hypothalamus); (b) Secretion of posterior lobe of pituitary—vasopressin. In absence of secretion or with injury of tuber, kidney is unable to secrete concentrated urine: thus NaCl administered increases volume but not salt content of urine.

Note.—Polyuria may occur with abdominal tumours, tuberculous peritonitis, injuries to spine: action may be vasomotor disturbance of kidney.

Symptoms.—(1) *General health good, patient usually thin but not emaciated*; (2) *Polyuria*; (3) *Thirst*; (4) *Appetite usually normal*. Constipation. Skin dry. Temperature subnormal. Blood normal, or erythraemia. Sugar tolerance normal or increased.

URINE.—Amount, often 10 to 20 litres (350 to 700 ounces). Specific gravity, 1001 to 1005. Almost colourless. Sugar and albumin absent, or trace of albumin in late stage. Urea and normal

Diabetes Insipidus—Symptoms—Urine, continued.

constituents in low percentage: daily excretion of urea, etc., variable. Inosite (muscle sugar) occasionally present, possibly 'washed' out from muscles by rapid passage of fluid.

In secondary group, various other signs due to cerebral tumour, etc.

Occasionally trace of sugar, from affection of pituitary gland.

In syphilitic cases, transient temporal hemianopia common.

Prognosis.—In primary group, often long life; death occasionally from pneumonia, or from alcoholism, though alcoholic tolerance is high (probably from dilution).

In secondary group, depends on lesion.

Diagnosis.—Wassermann reaction and radiograph of skull. Diagnosis from:—

1. **DIABETES MELLITUS.**—By absence of glycosuria and of hyperglycæmia.
2. **CHRONIC NEPHRITIS.**—By absence of albumin, casts, and arteriosclerosis.
3. **HYSTERICAL AND FUNCTIONAL POLYURIA.**—This is transient or intermittent: other signs of hysteria present.
4. **INTERMITTENT HYDRONEPHROSIS.**—Renal swelling, intermittent polyuria.

Treatment.—If syphilitic, usual treatment.

PITUITRIN.—Reduces polyuria. Action transient: few hours. Can be continued permanently.

FLUIDS.—Gradually reduce, but not after urine ceases to fall in amount.

CHAPTER CLXII.

DWARFISM AND INFANTISM

DWARFISM.—Extreme deficiency of stature below normal standards. Not necessarily infantilism—e.g., spinal caries.

INFANTILISM.—Retention, in varying degrees, of the characteristics of childhood—sexual, bodily, and mental.

Note.—The following classification is modified from Gardiner-Hill.

Dwarfism without Infantilism.—

1. **HEREDITARY.**—Well-known families exist.
2. **DEVELOPMENTAL SKELETAL DISEASES.**—E.g., achondroplasia, osteogenesis imperfecta.
3. **ACQUIRED SKELETAL DISEASES.**—Rickets, osteomalacia, spinal caries.

Dwarfism with Infantilism.—

1. **IDIOPATHIC.**—Type Lorain (see p. 911).
2. **CACHECTIC.**—Any chronic disease in childhood may delay development, with partial infantilism. This group includes

various primary and secondary factors, e.g., malnutrition, vitamin deficiency, rickets.

- a. *Cæliac disease*. Including various forms of steatorrhœa and deficient intestinal absorption. (See CÆLIAC DISEASE, p. 490.)
- b. Renal infantilism (see p. 663). Probably congenital factor
- c. Ankylostomiasis and hookworm infestations.
- d. Syphilis. Usually congenital.
- e. Mental and nervous deficiencies. Many types, e.g., microcephaly.
- f. Various. Malaria, heart disease, diabetes.

3. ENDOCRINE.—

- a. Thyroid: (i) Cretinism; (ii) Infantile myxœdema.
- b. Pituitary: (i) Simmonds' disease (onset in childhood); (ii) Frohlich's disease (see p. 907)
- c. Gonadal: Eunuchoidal types.

Type Lorain (*Ateleiosis*).—Present from birth. No cause known. *Manifestations*: Proportions of a miniature adult. No facial, pubic, or axillary hair. Sexual organs small, but proportional to size. Voice high-pitched. Intelligence varies; usually 'sharp', but mind remains childish; may appear normal.

Gonadal Infantilism (eunuchoidal types).—If primary, exhibits: (a) Excessive length of limbs, from slow ossification of epiphyses, thus differing from pituitary infantilism; (b) Defect of stature, thus differing from tall stature of true eunuchs

Effect of castration varies with age at which performed.

Progeria (Hastings Gilford).—Very rare. Dates from birth. Premature senility with *extreme fibrosis*, especially of arteries and kidney. Dry skin, loss of hair, and appearance of old age. Death before puberty. Cause unknown.

Brissaud's Type.—Was ascribed to hypothyroidism, but description agrees with early Simmonds' disease.

Mongolism.—Origin unknown. Often at end of large families. Mongoloid facies, short head, protruding tongue. Broad hand; short index finger. Mentally defective. Physical defects common—e.g., heart, strabismus, nystagmus, umbilical hernia.

Section XI.—DISEASES OF THE NERVOUS SYSTEM.

CHAPTER CLXIII.

SENSORY AND MOTOR PATHS.

I. PATHS OF SENSATION AND AFFERENT TRACTS.

1. In the Peripheral Nerves.—Three systems of sensory impulses exist, each with its own fibres:—

a. PROPRIOCEPTIVE OR KINÆSTHETIC SENSATION.—

Fibres convey sensations from muscles, joints, and bones, and ascend consecutively in muscle, tendon, and *motor* nerves. Functions: (i) Deep pressure and pain; (ii) Sense of passive position—muscle sense; (iii) Accurate localization of pressure; (iv) Discrimination of compass points; (v) Stereognosis, recognition of objects by feel.

b. PROTOPATHIC SENSATION (EXTEROCEPTIVE).—Fibres in sensory nerves. Functions: (i) Pain (pin-prick); (ii) Extremes of heat and cold—viz., below 20° C. and above 40° C. Sensation (e.g., pin-prick) radiates widely, and power of localization is very slight. Areas supplied overlap considerably.

c. EPICRITIC SENSATION (EXTEROCEPTIVE).—Fibres in sensory nerves. Functions: (i) Light touch; (ii) Temperature between 20° and 40° C.; (iii) Localization—very accurate. Also: tactile discrimination, e.g., compass points; acuçesthesia, e.g., appreciation of differences in size of objects. No overlapping of areas supplied.

Relations between areas of epicritic and protopathic loss vary with site of lesion: (i) In peripheral nerve; epicritic loss greater than protopathic, and difference increases as periphery is approached. (ii) In plexus: areas equal. (iii) In dorsal root: epicritic less extensive than protopathic. Kinæsthetic sensation is retained unless tendons are divided.

SENSORY CHANGES OCCURRING IN NERVE LESIONS.

a. PAIN.—Varies with cause and severity of lesion. In slow compression, slight or nil; in inflammation, very severe.

b. ANÆSTHESIA.—Varies with site and cause of lesion.

c. PARÆSTHESIA (numbness, tingling, etc.).—May occur with no anæsthesia.

d. HYPERALGESIA.—Especially in areas where epicritic sensation is lost and protopathic is present.

Objective sensory changes are generally less marked than motor changes.

2. In the Spinal Cord.—On entering the spinal cord, the sensory fibres are immediately rearranged and subsequently ascend in three fresh groups.

GROUPS OF SENSORY FIBRES IN THE SPINAL CORD.—

1. **TACTILE IMPULSES.**—Include: (a) Light touch (epicritic); (b) Deep touch (kinæsthetic).
2. **IMPULSES OF PAIN AND TEMPERATURE.**—Include: (a) All sensations of heat and cold, both epicritic and protopathic; (b) Pain, viz. (i) pin-prick (protopathic), (ii) bone pain (kinæsthetic).
3. **IMPULSES OF LOCALITY, PASSIVE POSITION, ETC.**—Include: (a) Localization of touch; (b) Tactile discrimination; (c) Acuæsthesia; (d) Sense of passive position; (e) Sense of muscle movement, or muscle sense; (f) Vibration.

All primary sensory neurons end about cells on the same side of the cord.

PATH OF THE THREE GROUPS IN THE SPINAL CORD.—

1. **TACTILE IMPULSES.**—(a) The primary sensory neurons at once enter the *posterior columns*, and ascend in these almost the entire length of the cord to the cuneate and gracilis nuclei. (b) Light touch fibres give off collaterals which enter the posterior horns and end around cells. (c) The fibres from these cells—i.e., secondary sensory neurons—immediately cross the cord in the anterior white commissure, and pass to anterior spino-thalamic tract (of the opposite side), forming an ascending tract between the anterior horn and Gowers' tract. Owing to this long course in the posterior columns and numerous collaterals, light touch is rarely completely abolished in lesions of the cord.

Termination of Anterior Spino-thalamic Tract.—In the medulla, the fibres are joined by other sensory fibres, e.g., from cuneate and gracilis nuclei, and later also by sensory fibres from the head. Combined tract forms the *median* (or mesial) *fillet* and ascends to optic thalamus.

2. **IMPULSES OF PAIN AND TEMPERATURE.**—The primary sensory neurons enter the *posterior horns*, and shortly end about cells. The secondary sensory neurons from these cross the cord obliquely in the course of several segments in the anterior white and posterior commissures close to the central canal, and ascend in the lateral spino-thalamic tract close to Gowers' antero-lateral ascending tract (of the opposite side). Syringomyelia injures the fibres while *crossing the cord*; being arranged here in order of heat, cold, pain, from within outwards, heat may be affected more than cold, and cold than pain.

Termination of Lateral Spino-thalamic Tract.—Joins the median fillet and ascends to optic thalamus.

3. **IMPULSES OF LOCALITY, PASSIVE POSITION, ETC.**—The primary sensory neurons at once enter the *posterior columns*, and ascend on the same side to the cuneate and gracilis nuclei. Collaterals from certain of the fibres end round

Paths of Sensation and Afferent Tracts in Spinal Cord, *continued*.

cells in Clarke's column, whence the secondary sensory neurons pass to the direct (on same side) and indirect (on opposite side) cerebellar tracts, and ascend in these. This group of impulses is affected in tabes.

Termination of Tracts.—Three tracts are formed:—

- i. *Fibres in posterior columns* ascend to and end in cuneate and gracilis nuclei. Relay fibres decussate in fillet, join median fillet of opposite side and ascend to antero-lateral nucleus of optic thalamus.
- ii. *Direct cerebellar, Flechsig, or posterior spino-cerebellar tract* ascends on same side through inferior cerebellar peduncle to vermis.
- iii. *Indirect cerebellar or Gowers' antero-lateral ascending tract* on opposite side passes through medulla and pons, and decussating again reaches the cerebellum on original side through the superior cerebellar peduncles. Certain fibres run to corpora quadrigemina.

The last two tracts convey impulses from muscles and joints to the cerebellum and are concerned in maintenance of *equilibrium*.

3. **In the Brain.**—There are two centres for conscious appreciation of sensations, viz., in optic thalamus and in cerebral cortex. All afferent fibres end in the optic thalamus.

OPTIC THALAMUS.—

1. A mass of gray matter. Is centre for conscious appreciation of certain *crude sensations*, especially of pleasure and discomfort, including pain, temperature, touch, and consciousness of changes of such states.

Cerebral cortex can control activities of this centre.

2. Other afferent fibres terminate here, and relays, conveying *finer sensations*, commence. They pass through posterior limb of internal capsule and corona radiata to cerebral cortex, where they reach consciousness.

CEREBRAL CORTEX.—Such impulses ascending to cortex are redistributed and collected into five main groups (Head and Holmes): (i) Recognition of position of limbs and body in space and of passive movements; (ii) Recognition of finer tactile differences and intensity of touch; (iii) Recognition of size, weight, shape, and texture of objects; (iv) Localization of a stimulated spot; (v) Sensations of temperature. They are localized in the cortex in order from the Rolandic fissure back to the supra-marginal and angular gyri.

II. MOTOR TRACTS.

Voluntary motor impulses commence in cerebral cortex, and on path to muscles pass through at least three neurons, i.e., upper and lower motor neurons and intermediate neurons. The upper motor neurons cross the mid-line.

Upper Motor Neurons.—

1. **CEREBRAL CORTEX.**—Fibres commence from large pyramidal (Betz) cells in motor cortex anterior to fissure of Rolando. Centres *from above downwards* are arranged in order : leg, trunk, arm, face. Or, in greater detail : anus, toes, ankle, knee, hip, abdomen, chest, shoulder, elbow, wrist, hand, thumb, neck, eyelids, ear, nose, mouth, and tongue.
2. **INTERNAL CAPSULE.**—The fibres, forming the pyramidal tracts, constitute and pass through the corona radiata to internal capsule, where they are arranged *from before backwards* in order : (i) In front of angle : (eyes and head). (ii) At angle : tongue, mouth. (iii) Anterior two-thirds of posterior limb : shoulder, elbow, wrist, fingers, thumb, trunk, hip, knee, ankle, toes. (In posterior third of posterior limb are sensory fibres ascending from optic thalamus to sensory cortex, and posterior to these are the optic radiations.)
3. **CRUS, PONS, AND MEDULLA.**—In the crus, pyramidal tract occupies middle two-fifths of crista. From here to medulla, certain fibres leave the tract, cross the mid-line, and terminate in nuclei of motor cranial nerves of opposite side. In the medulla, the pyramidal tracts form the anterior pyramids. Here most fibres cross mid-line, forming the 'decussation of the pyramids', and descend as the lateral or crossed pyramidal tract of the cord. Remaining fibres continue uncrossed as the direct pyramidal tracts.
4. **SPINAL CORD.**—Two tracts are present :—
 - i. **LATERAL OR CROSSED PYRAMIDAL TRACT.**—Situated in lateral columns. Connects with motor cells of anterior horns.
 - ii. **DIRECT PYRAMIDAL TRACT (Türck's).**—In anterior columns. Fibres cross in anterior white commissure and connect with anterior horns of opposite side. Crossing is complete at mid-thoracic region.

Intermediate Neurons.—Upper motor neurons of both tracts end about posterior horn cells on opposite side to their origin in cortex. Thence a relay passes to the anterior horns and connects with cells.

Lower Motor Neurons.—Fibres commence from motor cells of anterior horns, and pass through anterior roots and peripheral nerves to end-organs in the muscles. In the brain they commence from the cranial nuclei in pons and medulla.

Extra-pyramidal Motor Tracts.—Concerned with automatic actions. Convey involuntary motor impulses from ganglia in brain to anterior horn cells or intermediate stations.

1. **RUBRO-SPINAL TRACT (Bundle of Monakow).**—

ORIGIN.—From dentate nucleus (cerebellum) fibres cross to opposite red nucleus, in tegmentum of crus (cerebello-rubral tract). Rubro-spinal tract commences from red nucleus, immediately decussates with opposite tract, and crosses mid-line. Communications are effected with motor cranial

Motor Tracts—Extra-pyramidal—Rubro-spinal, continued.

nuclei. In the cord, tract is situated in lateral columns, anterior to crossed pyramidal tract, and fibres end in connection with anterior horn cells.

FUNCTION.—Main efferent cerebellar tract: connects cerebellum with same side of body (doubly crossed). Concerned in maintenance of equilibrium and co-ordination of antagonistic muscles (group movements).

In conjunction with this tract are:—

- i. *Lenticulo-rubro-spinal (Striato-rubral) Tract.*—Fibres from lenticular nucleus to red nucleus of same side: thus connects with opposite side of body.

Extra-pyramidal syndromes: Lesions of this and associated striate tracts produce Parkinsonism, athetoid and choreic movements, tremors, rigidity, and spasms (e.g., oculogyral), automatic and of special type, as in encephalitis, progressive lenticular degeneration, paralysis agitans, chorea.

- ii. *Thalamo-spinal Tract.*—Fibres from optic thalamus.

2. TECTO-SPINAL TRACT.—

ORIGIN.—From corpora quadrigemina; partial (Meynert's) decussation. In cord, situated in antero-lateral column anterior to rubrospinal tract. Ends round anterior horn cell.

FUNCTION.—Concerned in reflex actions dependent on auditory and visual stimuli (e.g., hitting a fast-moving ball).

3. VESTIBULO-SPINAL TRACT (Antero-lateral descending tract).—

ORIGIN.—From Deiter's nucleus, in the pons. Tract is uncrossed. In cord is situated in anterior columns, and fibres terminate about anterior horn cells.

FUNCTIONS.—Connects cerebellum with same side of body. Is concerned in tone of muscles and in position of body, especially in correlation with vestibular and ocular stimuli.

Deiter's nucleus (lateral nucleus of eighth nerve) has connections with: (i) Semicircular canals, through vestibular nerve; (ii) Cerebellum, roof nuclei, through middle peduncle; (iii) Motor nerves of eye, through posterior longitudinal bundle.

Other small tracts in cord also show descending degeneration:—

TRACT OF MARIE.—In anterior columns: is continuation of posterior longitudinal bundle.

OLIVO-SPINAL TRACT (Bundle of Helweg).—From optic thalamus through inferior olive. Close to vestibulo-spinal tract.

COMMA TRACT.—Between columns of Goll and Burdach. Consists mainly of descending branches of afferent fibres.

SEPTO-MARGINAL BUNDLE.—Adjoining posterior longitudinal fissure: mainly proprio-spinal fibres. (The last two tracts do not degenerate in tabes.)

Lesions of the Motor Tracts.—Destructive lesions of motor tracts result in paralysis of muscles supplied. Impulses from brain in upper neuron normally inhibit activities of lower neuron, which are increased in their absence. Nutrition of lower neuron is

independent of upper neuron, and its involuntary activities can continue when isolated. Two types of paralysis thus occur.

	<i>Upper Neuron Lesion</i>	<i>Lower Neuron Lesion</i>
1. Paralysis	Spastic	Flaccid
2. Wasting	From disuse only	Rapid and marked
3. Deep reflexes	Increased, e.g., knee-jerks, Babinski extensor reflex	Absent
4. Electrical reactions	Unchanged	Reaction of degeneration, partial or complete
5. Sensory and trophic changes	Absent	Present, degree varies
6. Contractures	Mainly of spastic muscles	Mainly of unantagonized muscles

Brown-Séguard's Syndrome.—Occurs in unilateral transverse cord lesions.

1. ON SIDE OF LESION.—

a. IN AFFECTED SEGMENT.—(i) Zone of anæsthesia, with area of hyperæsthesia above; (ii) Atrophic (lower motor neuron) paralysis.

b. BELOW AFFECTED SEGMENT.—(i) *Paralysis*, of upper motor neuron type. (ii) *Sensory changes*: Loss of sense of position, of localization of touch, and of tactile discrimination, e.g., size and shape of objects (stereognosis) and compass points, and also vibrations of tuning-fork.

2. ON OPPOSITE SIDE TO LESION.—Loss of sensation of pain and temperature. Touch may be slightly affected. No motor changes.

III. REFLEXES.

A reflex is a muscular contraction in response to an afferent, sensory, stimulus. Its occurrence involves the integrity of a 'reflex arc' including an afferent nerve, an efferent nerve (lower motor neuron), a connection between the two in the central nervous system, and a muscle capable of contraction.

A reflex may vary from normal in being: (1) *Diminished or absent*: from interruption at any point of arc. (2) *Increased*: impulses in upper motor neuron (pyramidal tracts) inhibit activity of lower motor neuron, and deep reflexes become increased if such impulses are interrupted. (3) *Altered in type*, e.g., Babinski's sign.

1. **Deep or Tendon Reflexes.**—Principal are: (i) *Knee-jerk*: segments of cord involved are second, third, and fourth lumbar. (ii) *Tendo Achillis*: first sacral segment. Also: jaw-jerk (fifth nerve), supinator (fifth cervical), triceps (sixth and seventh cervical).

2. **Superficial Reflexes.**—Principal are: (i) *Plantar reflex*: first, second, and third sacral segments. (ii) *Abdominal*: eighth to twelfth dorsal. Conjunctival, palate, cremasteric, and others.

Superficial abdominal reflexes are diminished in lesions of pyramidal tracts (cf. deep reflexes), e.g., in cerebral lesions.

Reflexes—Superficial, continued.

All superficial reflexes depend considerably on condition of skin—e.g., with cold, damp, or laxness, are often absent; should be tested for repeatedly, and absence must be cautiously interpreted.

Knee-jerks.—

A. INCREASED.—Cause may be: (1) Functional, e.g., hysteria, neuroses. (2) Organic, viz., interference with conduction of impulses in upper motor neuron, e.g.: (a) In brain: hemiplegia, dementia paralytica. (b) In cord: lateral sclerosis, disseminated sclerosis, transverse myelitis.

B. ABSENT.—Cause: interruption of reflex arc, due to: (1) Muscular weakness: e.g., muscular dystrophy. (2) Lesions of afferent or efferent nerves: e.g., peripheral neuritis, trauma. (3) Lesions of lumbar segments of cord, e.g.: (a) Posterior roots, tabes; (b) Anterior horns, poliomyelitis.

If response be slight or doubtful, test with Jendrassik's reinforcement method.

Ankle-clonus.—Often occurs with lesions of pyramidal tracts: when present is evidence of organic lesion. 'Spurious clonus' may be organic or functional.

Plantar Reflex: Babinski's Sign.—Stimulation of the sole in infancy produces upward movement of great toe, i.e., dorsiflexion, or 'extensor response'. After learning to walk, response becomes 'flexor': connected with action of great toe in walking. If the pyramidal tracts be interrupted, reflex again becomes 'extensor', i.e., a positive Babinski's sign.

Positive Babinski's Sign is definite evidence of organic lesion of upper motor neuron.

CHAPTER CLXIV.

DISEASES OF THE PERIPHERAL NERVES.

I. NEURITIS.

Causes.—Lesions of single peripheral nerves occur from: (1) *Trauma*: compression or division. Usual cause. (2) Extension of inflammation—e.g. from caries of bone. (3) Cold.

Morbid Anatomy.—*Interstitial neuritis*—i.e., inflammation of supporting fibrous tissue; later, nerve fibres are destroyed by pressure.

Symptoms.—With complete interruption of a mixed nerve, complete loss of motor, sensory, and trophic functions results. With partial interruption—e.g., by compression—sensory fibres suffer less than motor: there may be no sensory change, or slight epicritic loss.

1. **MOTOR SYMPTOMS.**—Of lower motor neuron type. (See p. 917.)

2. **SENSORY SYMPTOMS.**—See p. 912.

3. **TROPHIC CHANGES.**—*Skin*, in chronic conditions, dry, glossy, and tightly stretched; no sweating; often hairless; liable to

ulceration. *Nails* brittle and furrowed; growth slow (from diminished circulation). *Bones* may be more fragile. *Joints*: occasionally effusion, thickening, and rarely ankylosis.

Prognosis.—

SLIGHT LESIONS (contusions or compression).—Recovery in a few days or weeks.

NERVE DIVIDED AND SUTURED.—Progress usually:—

1. **PROTOPATHIC SENSATION.**—Commences in 2 to 3 months; complete in 6 months.
2. **EPICRITIC SENSATION.**—Commences in 6 months; complete in 1 year or more.
3. **MOTOR FUNCTIONS.**—In upper extremity, division near wrist: recovery in 1 year. Near elbow and in plexus: at least 2 years (Sherren).

Diagnosis.—Note:—

HYSTERICAL CONTRACTURES.—(1) All sensations affected over similar area; (2) 'Stocking' or 'glove' distribution; (3) No reaction of degeneration; (4) Flexors and extensors both affected. (*See HYSTERIA*, p. 1019.)

VOLKMANN'S ISCHÆMIC CONTRACTURE from tight bandages or splint.—(1) No anæsthesia; (2) No reaction of degeneration.

Treatment.—

OF DIVIDED NERVES.—Suture.

OTHER CAUSES AND GENERAL TREATMENT.—*See MULTIPLE NEURITIS, below.*

II. MULTIPLE NEURITIS.

(*Peripheral Neuritis. Polyneuritis.*)

Inflammation and degeneration of multiple peripheral nerves, resulting in disturbance of motor and sensory functions, usually affecting the limbs, and of symmetrical distribution.

Etiology.—

1. **TOXIC.**—*Alcohol, lead, arsenic,* and mercury. Rarely from other metals and organic substances.
2. **INFECTIOUS FEVERS**, especially *diphtheria*. Rarely enteric, influenza, and others.
3. **DIABETES.**

Occasionally:—

4. Malaria, gout, and possibly rheumatism. Rarely syphilis.
5. Cachectic conditions: cancer, anæmia, etc. Rare.
6. No obvious cause: cold, over-exertion.

Also dominating lesion in:—

7. *Beri-beri.*
8. *Leprosy.*

Morbid Anatomy.—Mainly *parenchymatous* neuritis, Wallerian degeneration of nerve fibres; interstitial changes slight.

Symptoms.—A general description of symptoms is given here, followed by an account of certain special forms, especially the alcoholic. Various causes have a selective action on special nerves. *See also* p. 921.

Multiple Neuritis—Symptoms, *continued*.

DISTRIBUTION.—Symmetrical. Distal portions of extremities nearly always first affected. Cranial nerves and those supplying trunk muscles rarely affected, except in special forms.

MOTOR SYMPTOMS.—Loss of power, especially in extensor muscles below knee and elbow, whence wrist-drop and foot-drop. Characteristics of lower motor neuron lesion present, viz.: (1) *Flaccid paralysis and wasting of muscles*; (2) Loss of deep reflexes; (3) Reaction of degeneration.

SENSORY SYMPTOMS.—Often *precede* motor symptoms. (1) Tingling, numbness, hyperæsthesia, anæsthesia; extent of alteration and impairment of sensation very variable. (2) *Tenderness of muscles*.

REFLEXES.—Deep reflexes lost. In lower extremities: *knee-jerks absent*, no ankle-clonus, plantar reflex flexor. (Occasionally in early stages of nerve irritation knee-jerks are increased, but tendo Achillis jerk rarely present.)

SPHINCTERS.—Unaffected.

ELECTRICAL REACTIONS.—May be simple diminution of excitability, stronger currents being necessary to produce contractions; or may be reaction of degeneration.

STEPPAGE GAIT.—When lower extremities affected. Due to foot-drop from weakness of extensors. *Foot lifted high* to clear toes from ground, thrown forward, and slapped flat on ground.

OTHER CHANGES may be:—

TROPHIC.—In late stages. Skin smooth and glossy. Nails brittle and cracked.

VASOMOTOR.—Not common. May be oedema.

ATAXIA.—Usually absent, but in rare cases (alcoholic) marked.

CONTRACTURES of muscles and resulting deformities may occur in chronic cases.

Neuritis may spread along nerve trunks, usually upwards; or distribution extend to fresh nerves, and muscles of respiration may be affected.

Alcoholic Peripheral Neuritis.—Commoner in women. Age, 30 to 40 years. Especially chronic tipplers. *Onset* gradual. Distribution symmetrical. (See also **ALCOHOLISM**, p. 309.)

INITIAL SYMPTOMS.—Tingling in feet and hands. Twitching muscles. Cramps in calves.

GENERAL CHARACTERISTICS:—

1. Weakness and paralysis. Onset in lower extremities, mainly extensors and calf muscles, whence foot-drop and steppage gait. Later, hands and forearms.
2. Rapid wasting of affected muscles, mainly below knee.
3. Tenderness of muscles, especially of *calves*. Sometimes soles of feet.
4. Deep reflexes lost: knee-jerks and ankle-jerks absent.
5. Sensory changes variable. Most in early stages. Numbness and tingling usual. Pains slight, or occasionally severe, and nerve-trunks tender. Some anæsthesia usual, partial or complete.

6. Sphincters unaffected. (With mental changes incontinence may occur.)
 7. Hands and feet become congested when hanging down.
 8. Mental changes common, especially Korsakow's syndrome; also delirium, convulsions (*see* ALCOHOLISM, p. 309).
- Paralysis may extend, involving muscles of respiration. Face rarely affected.

PROGNOSIS.—Usually good, even in severe cases with long period before improvement commences. May be many months. Small muscles may remain wasted: steppage gait may persist. From mental symptoms, complete recovery is rare. Cardiac degeneration and pulmonary tuberculosis may be fatal.

DIAGNOSIS.—Especially from:—

1. ARSENICAL NEURITIS (*see below*)
2. TANN'S —In rare forms of neuritis with marked ataxia. Note absence of pupil changes, sphincter troubles, and optic atrophy; presence of steppage gait and tender muscles; electrical reactions; congestion of hands.

Arsenical Multiple Neuritis (*see* ARSENIC POISONING, p. 320).—Closely resembles alcoholic form. In diagnosis, note: (1) Other signs of arsenical poisoning, especially skin changes; (2) Commences in feet rather than in calves (thus differing from alcoholic); (3) Pain commoner and severer; (4) Progress and muscular atrophy more rapid.

Diphtheritic Multiple Neuritis (*see* DIPHTHERIA, p. 44).—Selective action on nerve-supply of eye muscles, palate, pharynx and larynx, and muscles of respiration.

Multiple Neuritis from Lead, Beri-beri, Leprosy, etc.—*See* LEAD POISONING, p. 316, BERI-BERI, p. 370, LEPROSY, p. 116, etc.

Acute Febrile or Toxic Polynouritis.—A rapidly ascending polyneuritis. Some cases may be aberrant encephalitis lethargica.

ETIOLOGY.—Usually no obvious cause. Possibly cold, fatigue, etc.

ONSET.—Resembles acute specific fever: Sudden onset, rigors, pains in back and limbs, headache and malaise, high temperature.

SPECIAL CHARACTERS—

1. PARALYSIS commences in legs, and rapidly ascends. May involve intercostals, and in fatal cases the diaphragm; face usually escapes, also sphincters (not invariably). Muscles flabby, and waste very rapidly.
2. SENSORY CHANGES variable. Pain may be slight or severe, with or without anæsthesia.

PROGRESS.—Severe forms: death in 2 to 10 days. If patient survives initial period, prognosis is surprisingly good, but recovery needs 1 to 2 years.

DIAGNOSIS.—*See* LANDRY'S ACUTE ASCENDING PARALYSIS, p. 946.

General Prognosis.—

WHEN CAUSE IS REMOVABLE, prognosis is good, even with extensive paralysis. Improvement at the commencement may

Multiple Neuritis—General Prognosis, *continued*.

be slow, and occupy many months, with final recovery almost complete. Muscles recover in inverse order to involvement.

RESIDUAL CHANGES may be: (1) Permanent wasting and weakness of small muscles of hands, or of peronei; (2) Steppage gait; (3) Contractures; also (4) Mental changes in alcoholism.

IN ACUTE PROGRESSIVE FORMS, mortality varies with: (1) Rapidity of extension; (2) Involvement of respiratory muscles. Mortality high from latter.

General Diagnosis.—Usually simple, by the characteristics: (1) Symmetrical; (2) Flaccid paralysis; (3) Muscular wasting; (4) Reflexes absent; (5) Reaction of degeneration present; (6) Tender muscles; (7) Sensory changes; (8) Sphincters unaffected; (9) No pupil changes. Ataxia rare. Diagnosis from:—

IN EARLY STAGES.—Acute rheumatism.

IN CHRONIC FORMS.—Progressive muscular atrophy. Multiple neuritis is characterized by more rapid onset, wide distribution, sensory changes, tenderness of muscles.

IN ACUTE FORMS.—(1) Acute myelitis of lumbar enlargement. (Sphincters affected; pyrexia. When myelitis above lumbar enlargement, symptoms are of upper motor neuron lesion, and anæsthesia extends to trunk.) (2) Acute poliomyelitis. (Paralysis less symmetrical; proximal segments may be affected.) (3) Landry's acute ascending paralysis (*see* p. 946). (4) Tabes. (5) Trichiniasis.

Treatment.—**GENERAL.—**

REMOVE THE CAUSE.

REST IN BED.—Essential: 3 to 6 weeks or more. Also saves heart and respiratory muscles.

DIET.—Generous, especially vitamin B.

Water-bed preferable. Wrap limbs in cotton-wool.

SPECIAL INDICATIONS IN EARLY STAGES.—

PAIN.—Often eased by cradle and arrangement of limbs. Hot fomentations.

Drugs: Salicylates, aspirin; morphia as last resort.

SLEEPLESSNESS.—Bromides or paraldehyde.

CARDIAC WEAKNESS (especially in alcoholics).—Digitalis and strychnine.

PREVENTION OF CONTRACTURES AND STRETCHING OF MUSCLES.—e.g., foot-drop and contraction of hamstrings.—Very important. By splints, celluloid splints, and sand-bags.

IN LATER STAGES.—

MASSAGE AND PASSIVE MOVEMENTS.—Not in acute stages, but commence when calves are less tender, or wasting begins.

ELECTRICAL TREATMENT.—As in MASSAGE.

AS MUSCLES RECOVER, *encourage use*, in playing draughts, etc.

DRUGS.—Tonics of iron and strychnine. Arsenic in all cases except arsenical neuritis. Sodium salicylate and potassium iodide may ease pain in early stages.

III. DISEASES OF THE SPINAL NERVES.

1. CERVICAL PLEXUS.

Phrenic Nerve.—

CAUSES OF PARALYSIS.—

1. Fractures, tumours, etc., of spine involving anterior horns of 3rd and 4th cervical segments or the nerve roots.
2. Diphtheritic neuritis; rarely alcoholic or lead neuritis.
3. Wounds, tumours in neck. (Never in thoracic aneurysm.)
4. Pressure in mediastinum.
5. Avulsion. For pulmonary tuberculosis or bronchiectasis. Occasionally no obvious cause (unilateral only).

CHARACTERISTICS.—*Diaphragm paralysed.* Results:—

1. Respiration by intercostals and accessory muscles. Epigastrium drawn in during inspiration. Often noticeable only on deep respiration. Lower intercostals may also be paralysed. May be no abnormality when unilateral.
2. Dyspnoea on slight exertion. Respiration at rest usually normal.
3. Congestion at base of lungs usual.
4. X rays show deficient movement of diaphragm.

PROGNOSIS in bilateral forms.—Bad: respiratory failure or pneumonia.

DIAGNOSIS.—Difficult, especially in women. In unilateral lesions, affected side of the thorax moves more than the normal side. Deficient movement occurs from inflammation above or below diaphragm.

Hiccup.—Involves spasm of: (1) Diaphragm; (2) Glottis.

CAUSES.—

1. IRRITATION OF DIAPHRAGM: e.g., pepper, hot fluids, gastric distension.
2. IDIOPATHIC. EPIDEMIC. ENCEPHALITIS.
3. REFLEX in abdominal diseases: peritonitis (general or local), intestinal obstruction, enteric, dysentery, etc.
4. HYSTERIA. Also in intracranial tumours and disease.

TREATMENT.—

MILD FORMS.—Holding the breath; long draught of water.

SEVERE FORMS.—Often obstinate. Blister to epigastrium; firm traction on tongue for one to two minutes; bromides; faradization of epigastrium or phrenic nerve. Most effective are injections of morphia, chloroform inhalation, or anæsthesia.

2. BRACHIAL PLEXUS.

Lesions usually affect a portion only, rarely entire plexus. Causes are almost all traumatic, either supraclavicular (usually laceration) or infraclavicular (mainly compression). Lesions of the plexus are considered first; then those of the separate branches.

Diseases of the Spinal Nerves—Brachial Plexus, *continued*.

Lesions of the Plexus.—

CAUSES.—

1. TRAUMA TO NECK.—Blows, wounds, falls on neck, or violent drag on arm.
 2. OBSTETRICAL PARALYSIS.—In this and the first group the injury may stretch or tear the plexus, either all, or frequently only the upper cord.
 3. FRACTURES AND DISLOCATIONS compressing cords—e.g., dislocated humerus, fractured clavicle, or resulting callus.
 4. CERVICAL RIB.—Especially affects lower cord.
- Rare causes are: Tumours; subclavian aneurysm in neck; toxic neuritis.

VARIETIES.—(1) Complete. (2) Partial—common forms being:
 (a) Upper arm type, C5 and C6 (Erb-Duchenne paralysis);
 (b) Lower arm type, C8 and D1 (Klumpke's paralysis).

1. COMPLETE LESION.—Arm hangs to side. Results in:—
 - i. Complete motor and sensory paralysis of extremity. *Serratus magnus*, rhomboids, and levator anguli scapulæ escape. Flaccid paralysis of lower motor neuron type.
 - ii. Pupil small and palpebral fissure narrowed (branch of D1 to sympathetic system). May be slight enophthalmos.
2. PARTIAL LESION.—
 - a. UPPER ARM TYPE: ERB-DUCHENNE PARALYSIS.—(Obstetrical palsy.)

Lesion: 5th cervical root, and sometimes also 6th; usually rupture.

Muscles affected: Deltoid, biceps, brachialis anticus, supinator longus; may be others, varying with lesion.

Position of arm: Hangs at side, rotated inwards.

Movements lost: (i) Abduction of arm; (ii) Flexion of elbow; (iii) Supination of hand.

Sensory changes: Slight.
 - b. LOWER ARM TYPE: KLUMPKE'S PARALYSIS.—(Usually from compression, or residual from extensive paralysis of plexus.)

Lesion: 8th cervical and 1st dorsal root.

Muscles affected: (i) Intrinsic muscles of hand; may also affect (ii) Flexors of wrist and fingers.

Motor changes: Claw hand develops. If flexors are affected, inability to grasp.

Sensory changes: Numbness or anæsthesia, inner side of forearm and hand.

Eye changes: Pupil contracted, palpebral fissure narrowed, slight enophthalmos, on side of lesion. May be absent.

Cervical Ribs.—

GENERAL CONSIDERATIONS.—

1. Ribs usually bilateral, with unilateral symptoms, commonly on left.
2. Symptoms in 5 to 10 per cent only.
3. Onset in early adult life; generally women.

4. Numerous varieties of ribs, from rudimentary to well-formed. Similar symptoms occur, rarely, with an abnormal first dorsal rib.

Late onset is due to dropping of shoulder and not to late ossification of rib.

SYMPTOMS.—Due to compression of 1st dorsal nerve, 8th cervical nerve (to less extent), and artery:—

1. *Pain.*—Initial, commonest, and may be sole, symptom. Pain, numbness and tingling in ulnar border of forearm to wrist and fingers. Sensory changes often slight.
2. *Motor symptoms.*—Wasting and paresis of intrinsic muscles of hand.
3. *Weak radial pulse, strengthening on lifting arm.* Not common.

Occasional symptoms: Dissociated anæsthesia. Vasomotor changes. Pains in neck and back of head. Subclavian aneurysm. Thrombosis. Pupillary changes.

DIAGNOSIS.—By palpation and X rays. Always consider in wasting of one hand.

TREATMENT.—Symptomatic. Removal of rib: results vary.

Long Thoracic Nerve (Nerve of Bell).—(From C5, C6, and C7.) Supplies the serratus magnus.

SERRATUS MAGNUS PARALYSIS.—Isolated paralysis from:—

1. Injury in neck: especially carrying weights. Also rarely by wounds in axilla, or violent contraction of scalenus medius.
2. Primary neuritis. Cold.

It also occurs, with other lesions, in dystrophies and progressive muscular atrophy.

FUNCTIONS OF MUSCLE.—(1) Draws scapula forward; (2) Rotates inferior angle up and forwards.

SYMPTOMS.—

1. With arms at rest: deformity slight; inferior angle of scapula slightly prominent and tilted towards spine.
 2. When arms are held horizontally: scapula becomes 'winged'.
 3. Impairment of power of pushing.
 4. Arms cannot be raised above horizontal.
- No sensory changes in pure lesions. Trapezius often affected.

Circumflex Nerve.—(From posterior cord of brachial plexus, C5 and C6.)

CAUSES OF PARALYSIS.—(1) *Injuries to shoulder*, by dislocation, fracture, or blows; by crutches; occasionally during operations. (2) *Arthritis*, inflammation spreading from joint. (3) From cold, diabetes, lead, etc.: very rarely.

MUSCLES SUPPLIED.—Deltoid; teres minor. A branch is sent to the shoulder-joint.

SYMPTOMS.—

1. Arm cannot be raised or rotated outwards.
2. Wasting over shoulder.
3. Pain, often severe, and impaired sensation over shoulder.

Diseases of the Spinal Nerves—Circumflex Nerve, *continued*.

4. Groove between head of humerus and acromion, from relaxation of joint.

In chronic cases, adhesions may form in joint.

DIAGNOSIS.—From joint disease. Note electrical reactions. Suprascapular nerve often affected also.

Musculospiral Nerve.—(From posterior divisions of C5, C6, C7, and C8.) Paralysis common.

CAUSES.—(1) *In axilla*: Dislocations, fractures, callus, crutches.

(2) *In course round humerus*: Pressure between bone and hard substance—e.g., sleeping with arm over back of a bench. Occasionally: Neuritis from cold. Rarely: Strong contractions of triceps. *Lead palsy* affects certain branches.

SYMPTOMS.—

CHARACTERISTIC SYMPTOM.—Radial paralysis: 'wrist-drop' and inability to extend fingers at metacarpo-phalangeal joints: from paralysis of extensors of wrist and fingers. (Interossei unaffected.)

OTHER SYMPTOMS.—When injured in axilla, triceps, brachialis anticus, and supinator longus also affected, with loss of extension at elbow and supination, but latter effected by biceps when elbow flexed.

SENSATION.—Numbness and tingling in distribution, mainly radial side of hand. Sensory changes variable, often absent, or anæsthesia of radial branch.

ELECTRICAL REACTIONS.—In pressure palsies may be normal below site of injury, but nerve inexcitable above.

DIAGNOSIS.—Usually simple: lesion unilateral. In lead palsy, lesion is bilateral and supinator longus escapes.

PROGNOSIS.—Pressure palsies usually recover in a few days; permanency is rare.

Ulnar Nerve.—(From inner cord of brachial plexus, C8 and D1.)

CAUSES OF PARALYSIS.—(1) *Wounds of forearm*. (2) *Injuries at elbow-joint*: symptoms may commence after long interval. Rarely: nerve dislocated from groove at olecranon; neuritis from cold, etc. Always affected in leprosy.

MUSCLES SUPPLIED.—Flexor carpi ulnaris and ulnar half of flexor profundus digitorum (branches in forearm); interossei; two inner lumbricals; small muscles of little finger; adductor of, and inner head of short flexor of, thumb.

RESULTS OF LESION.—Vary with site:—

1. AT OR ABOVE ELBOW.—(a) Flexion of wrist feeble and incomplete; attempt causes radial deviation. (b) Wrist hyperextends on straightening fingers. (c) Fingers extended at metacarpo-phalangeal joint and flexed at others: in index and middle fingers less marked, owing to escape of lumbricals (median nerve). (d) All movements of little finger lost. (e) Separation of fingers lost. (f) True adduction of thumb lost.

2. LESION NEAR WRIST.—'Claw hand' rapidly develops, from escape of flexor profundus digitorum and unopposed action

of long flexor and extensors (index and middle fingers rather less than others). Thumb abducted.

MUSCULAR WASTING marked: hypothenar eminence, interosseal spaces, and between thumb and index finger.

LOSS OF SENSATION.—Over 5th finger, and ulnar half of 4th finger and pulp and nail. Protopathic sensation lost over smaller area, and deep sensibility present. When lesion is below dorsal cutaneous branch, loss is much less extensive (Sherren).

DIAGNOSIS.—From lesions of lower cord of brachial plexus. Characteristics are: (1) Claw-hand; (2) Muscular wasting; (3) Sensory changes.

Median Nerve.—Rarely affected alone.

CAUSES OF PARALYSIS.—(1) Wounds on palmar surface of wrist. (2) Wounds in forearm or arm. Occupation palsies affect muscles supplied by median nerve.

RESULTS OF LESION.—These vary with site:—

1. **LESION AT ELBOW.**—Movements lost are: Pronation of forearm; flexion of wrist (feebly present, with ulnar deviation); flexion of all interphalangeal joints except two distal joints of two ulnar fingers; abduction of thumb.
2. **LESION AT WRIST.**—Thumb movements mainly affected, especially abduction.

MUSCULAR WASTING of thenar eminence.

LOSS OF SENSATION.—Variable. On palmar aspect, three and a half fingers; on dorsum, last two phalanges of index and middle fingers and radial half of 4th finger (Sherren). Protopathic loss of slightly less extent. Deep sensibility retained.

3. LUMBAR AND SACRAL PLEXUSES.

Lesions of nerves of lower limb are rarer than those of upper limb.

Obturator Nerve.—Isolated lesion rare.

CAUSES.—Injuries occur in parturition. Rarely from pelvic growths or obturator hernia.

RESULTS OF LESION.—

LOSS OF MOVEMENTS.—(1) Adduction of thigh (leg cannot be crossed over other); (2) Outward rotation (obturator externus).

LOSS OF SENSATION, OR PAIN.—Inner side of lower half of thigh. Often indefinite.

Anterior Crural Nerve.—(From L₂, L₃, and L₄.) Isolated lesion rare.

CAUSES.—(1) Dislocation and fractures of femur, or wounds in groin. (2) Psoas abscess, or abdominal tumour. (3) Arthritis of hip. (4) Constipation (neuralgia).

RESULTS OF LESION.—

LOSS OF MOVEMENTS.—Extension of knee. Walking is possible. **WASTING** of quadriceps muscle, with reaction of degeneration. **KNEE-JERKS** absent.

LOSS OF SENSATION, OR PAIN.—(1) Lower two-thirds of anterior and inner side of thigh; (2) Inner side of leg to big toe (internal saphenous).

Diseases of the Spinal Nerves—Anterior Crural Nerve, *continued*.

CONTRACTURE of flexors occurs, if neglected.

Note.—Injury near plexus: psoas also affected, with loss of flexion of thigh. Somewhat lower: psoas escapes, but flexion weak, from paralysis of iliacus.

DIAGNOSIS.—From wasting in hip-joint disease: no reaction of degeneration.

Superior Gluteal Nerve.—Loss of abduction of thigh.

External Cutaneous Nerve.—‘*Meralgia paræsthetica*’ is characterized by pain and paræsthesia on front and outer side of thigh; may be severe; sensory changes slight.

Commoner in males: in females usually in pregnancy.

Probably neuritis from trauma in course under Poupart’s ligament near anterior superior spine of ilium.

TREATMENT.—Excision of nerve. Sometimes fails.

Sacral Plexus.—Lesions not common.

CAUSES.—Lesions may arise from: (1) Pelvic tumours, caries, or inflammation. (2) Parturition: foetal head compresses higher roots against brim of pelvis (i.e., mainly external popliteal fibres). (3) Rarely, neuritis extending from sciatic nerve.

SYMPTOMS.—Resemble incomplete sciatic paralysis, but may include: (1) Glutei and external rotators of thigh, if upper roots involved; (2) Anæsthesia on the back of thigh, buttocks, and perineum, if lower roots involved (small sciatic nerve).

Sciatic Nerve.—(From L₄, L₅, S₁, S₂, and S₃.)

CAUSES OF PARALYSIS.—(1) Fractures of pelvis or femur, or dislocations. (2) Wounds in leg. (3) Parturition: (a) In mother; (b) In infant from traction on leg. Nerve divides into two main branches high in thigh, and one may escape in wounds.

RESULTS OF LESION.—

LOSS OF MOVEMENTS.—(1) Injury at notch: paralysis of (a) flexors of knee, (b) muscles below knee. (2) Injury below middle of thigh: flexors of knee escape.

LOSS OF SENSATION.—Outer half of leg, and all the foot, except small area on inner side of dorsum.

WASTING OF MUSCLES.

TROPHIC CHANGES not uncommon.

External Popliteal Nerve (Peroneal Nerve).—

CAUSES OF PARALYSIS.—(1) Trauma in course round fibula, (2) Wounds in popliteal space. Occasionally: (3) Prolonged kneeling—nipped by biceps cruris tendon. Rarely: (4) Neuritis, primary or lead poisoning, tibialis anticus usually escaping.

MUSCLES SUPPLIED.—Peronei; long and short extensors of toes; tibialis anticus.

RESULTS OF LESION.—

MOTOR CHANGES.—(1) *Foot-drop*; (2) Toes flexed; (3) Foot commonly inverted, especially if tibialis anticus escapes, but varies with muscles affected. Sequels: (a) Steppage gait; (b) Talipes equinus (if internal popliteal unaffected).

LOSS OF SENSATION.—Outer half of front of leg and dorsum of foot to end of proximal phalanges of toes.

Internal Popliteal Nerve.—Course protected and injury rare.

RESULTS OF LESION.—

LOSS OF MOVEMENTS.—(1) Extension of foot; (2) Flexion of toes, whence inability to stand on tip-toe. Foot is everted (by peroneus longus). Sequels: (a) Talipes calcaneo-valgus; (b) Claw-foot, from contractures.

LOSS OF SENSATION.—Outer side and back of lower third of leg. Sole, and entire distal phalanges of toes.

Diagnosis of Lesions of Sciatic Nerve and Branches.—From:

- (1) Cauda equina, and sacral segments of cords. In these:
- (a) Lesions are bilateral; (b) Sphincters are affected; (c) When lesion is in cord all roots are affected below level of disease.
- (2) Sacral plexus: Distribution of paralysis and anæsthesia.

IV. MULTIPLE NEUROFIBROMATOSIS.

(*Von Recklinghausen's Disease.*)

An obscure disease originally recognized by neurofibromatosis. Is possibly a congenital dysplasia. Observation of extensive manifestations is recent.

Note: Tumours may become sarcomatous

Etiology.—Frequently familial and hereditary; usually *formes frustes* more numerous than complete types. Commences in childhood. Other lesions may coexist, e.g., syringomyelia.

Symptomatology.—Five groups of symptoms: (1) Neurological; (2) Cutaneous; (3) Skeletal; (4) Endocrine; (5) Psychical.

1. NEUROLOGICAL MANIFESTATIONS.—Due to *neurofibromata*. May affect:—

- a. **MAIN TRUNKS OF NERVES.**—Sensory, motor, or autonomic. Tumours hard, painless; often no nerve symptoms, but these may be caused by pressure.
- b. **TERMINAL FILAMENTS OF PERIPHERAL NERVES.**—*Peripheral neurofibromatosis*. Tumours very numerous; often pedunculated, constituting '*molluscum fibrosum*'.
- c. **SINGLE NERVE AND ALL ITS BRANCHES.**—May be hypertrophy of skin and subcutaneous tissues in affected area. Constitutes '*plexiform neuroma*'.
- d. **SPINAL ROOTS AND CRANIAL NERVES.**—*Central neurofibromatosis*. Auditory nerve commonest. (**Note:** Relation to the ordinary single tumour of nervus acusticus is uncertain.)

2. CUTANEOUS MANIFESTATIONS.—

- a. **PIGMENTARY CHANGES.**—(i) Diffuse pigment or patches of vitiligo. Areas may be hyperplastic and raised. Face usually escapes, but may be affected alone ('*chloasma*'). (ii) '*Café-au-lait*' areas.
- b. **NÆVOID FORMATIONS.**—From '*spider nævi*' to '*port-wine stains*'.

Multiple Neurofibromatosis—Symptomatology, *continued*.

c. 'BLUE-SPOTS'.—Are neurofibromata in skin : later project and lose tint.

(Also 'molluscum fibrosum' : *see above*.)

3. SKELETAL CHANGES.—

a. SPINAL CURVATURES.—Rare : partial pressure paraplegia.

b. EXOSTOSES.—Especially cranial bones.

c. SUBPERIOSTEAL CYSTS.

d. OSTEOPOROSIS.—(? Osteomalacia.)

e. CHANGES IN JOINTS.

4. ENDOCRINE CHANGES.—Any endocrine gland may be affected—e.g., acromegaly may occur.

5. PSYCHICAL CHANGES.—Mental weakness common.

Formes Frustes and Incomplete Forms.—One group—e.g., cutaneous—may precede others for many years.

Amputation Neuromata.—On central end of nerves divided by injury or operation. Very painful.

TREATMENT.—Removal ; but may recur.

V. SCIATICA.

Pain in distribution of sciatic nerve arises from : (1) Neuritis ; (2) Pressure on nerve or roots by tumours, etc. ; (3) Neuralgia neurosis.

1. NEURITIS.—Cold or wet : common causes. Gout. Rheumatism, especially spondylitis. Common in alcoholics. Occasionally in diabetes (bilateral) ; gonorrhœa, syphilis. Trauma rare.
2. ORGANIC CAUSES.—Pelvic tumours—e.g., uterine, foetal head, or even full rectum.

Etiology.—Common in males. Rare under middle age.

Morbid Anatomy.—Interstitial neuritis. Nerve red and swollen.

Symptoms of Neuritis.—

1. PAIN IN COURSE OF NERVE.—Characters : (a) Unilateral ; (b) Onset gradual, usually in upper thigh ; at first following exertion or in positions stretching nerve. (c) Becomes constant, often with paroxysms ; worse at night, on walking, or any sudden movement. (d) Severity increases and distribution extends ; may involve entire nerve.
2. NERVE TENDER ON PRESSURE.—Especially over sciatic notch, mid thigh, popliteal space, and outer side of fibula.
3. PAIN ON STRETCHING NERVE (Lasègue's sign).—Flex hip and extend knee.
4. MUSCULAR WASTING, in chronic cases. Moderate degree. No reaction of degeneration.
5. NO CUTANEOUS HYPERÆSTHESIA, except over nerve trunk.

OTHER FEATURES.—*Walks* with knee bent, on toes, to relax nerve. *Knee-jerks* usually brisk. *Ankle-jerks* often lost. *Skin* generally dry and cold, occasionally sweating and trophic changes. *Cramps* and *spasms* not very common : usually at night. *Scoliosis* may develop : concavity usually away from affected side. *Fibrous nodules* common in lumbar and gluteal muscles.

HIGH SCIATICA.—Sicard divides the site of neuritis into many groups. The most important is often called 'high sciatica'—situated within the bony canal and as far down as the posterior root ganglion. It is said that lymphocytes are present in the cerebrospinal fluid with origins within the bony canal.

BILATERAL AND UNILATERAL SCIATICA.—True sciatica is usually unilateral, but may be bilateral, and is generally so in diabetes. Most general causes and conditions within the pelvis result in bilateral pain.

Course.—Duration variable, often obstinate. Remissions common.

Diagnosis.—X-ray of spine, pelvis, and hip-joint. Wassermann reaction. Rectal examination.

1. **PELVIC TUMOURS, PELVIC DISEASES, ETC.**—Note: (a) Area of sensory changes; (b) Reaction of degeneration and advanced muscular atrophy; (c) Absence of knee-jerks. Nerve trunk is not tender. Note *sacro-iliac disease*.

2. **HIP-JOINT DISEASE.**—Pain on *rotating thigh* or pressure on trochanter. Nerve trunk not tender.

3. **LUMBAGO.**

4. **TABES.**

5. **INTERMITTENT CLAUDICATION.**—After exertion only. Distribution not of nerves.

6. **LESIONS OF CAUDA EQUINA.**—Bilateral. Sphincters affected. Sensory changes.

Bilateral sciatica suggests general and intrapelvic causes.

Treatment.—

APPROPRIATE TREATMENT OF SPECIAL CAUSES.—Gout, gonorrhœa, syphilis, etc. Bowels opened regularly.

REST IN BED.—Advisable in all cases, for a few days to 3 to 6 weeks. Leg elevated on inclined plane: kept at rest, if necessary with long splint.

HEAT ALONG COURSE OF NERVE.—Hot bottles, hot sand-bags, hot iron, or baths.

COUNTER-IRRITATION.—Blisters, cautery along nerve.

DRUGS.—Often ineffectual. Best are alkalis, sodium salicylate, and potassium iodide. In acute pain: phenacetin, aspirin, etc.; morphia as last resort.

ELECTRICITY.—Effects variable.

HYDROTHERAPY, SPA TREATMENT.—Advantageous in elderly patients.

INJECTIONS.—*Epidural injections*: often rapidly effective in high sciatica. *Into nerve*: insert needle into nerve near sciatic notch, about 2 inches deep: causes pain in distribution. Inject a few c.c. of 2 per cent novocain; then, slowly, 50 to 100 c.c. of warm normal saline. Repeat weekly, two or three times. (Distilled water also used.)

MESSAGE FOR NODULES.—*In chronic cases*, to strengthen muscles.

CHAPTER CLXV.

DIFFUSE AND LOCAL DISEASES OF THE SPINAL CORD.

I. MYELITIS.

By analogy with the meaning usually involved in its termination, *myelitis* should denote inflammation. In general, it is applied in a wider, and etymologically more correct, sense to disease of the spinal cord.

Etiology.—

1. IDIOPATHIC.—Cold, exposure, etc., possible factors.
2. SYPHILIS.—Only cause of a *chronic* myelitis; others are acute or subacute. (This form is not referred to in this section. See SYPHILIS OF THE NERVOUS SYSTEM, p. 985.)
3. COMPRESSION MYELITIS.—Commonly from caries, trauma, tumours, aneurysm. (See p. 936.)
4. TRAUMA.—Fracture of spine. Rarely, concussion without fracture.
5. ACUTE SPECIFIC FEVERS.—*Rare*: most often in enteric influenza. *Very rarely*, in gonorrhœa, measles, dysentery, and other specific infections.
6. TUMOURS OF CORD, MENINGITIS OF CORD.—*Rare*.
7. ACUTE POLIOMYELITIS.

NOTE.—*Acute myelitis only* is referred to below.

Morbid Anatomy.—Lesion may be: (1) *Transverse myelitis*: (2) *Diffuse or disseminated myelitis*, extending over wide or scattered areas: of inflammatory origin; leucocytic infiltration marked.

MACROSCOPIC CHANGES.—Cord swollen and soft: in severe forms, diffident. Meninges injected. On section, no distinction between white and gray matter; often hyperæmia.

HISTOLOGY.—(1) Blood-vessels: distended; thrombi common. Perivascular lymph spaces infiltrated with cells, mainly mononuclear. (2) Nerve-cells: swollen and irregular, nuclei degenerated, cytoplasm granular and fatty. (3) Nerve fibres: myelin sheaths swollen, do not take Weigert-Pal's stain, and show fatty degeneration (Marchi's method); axis cylinders irregular and degenerate later.

LATER STAGES.—Usually less acute forms. Two characteristics: (1) *Sclerosis* of affected area, by proliferation of neuroglia; (2) *Ascending and descending degenerations*, tracts later becoming sclerosed.

Clinical Types of Acute Myelitis.—(1) *Acute transverse myelitis*: (a) Dorsal; (b) Cervical; (c) Lumbo-sacral. (2) *Acute diffuse or ascending myelitis*, disseminated myelitis.

1. Acute Transverse Myelitis.—

ONSET rapid; symptoms at maximum within few days.

INITIAL SYMPTOMS may be either: (1) Motor: weakness and stiffness in legs. (2) Sensory: numbness, tingling, or aching. (3) Girdle constriction at level of lesions. Constitutional symptoms (pyrexia, etc.) slight or absent.

a. Dorsal Myelitis.—Commonest form; usually about 6th to 8th dorsal segment.

SYMPTOMS.—

1. PARALYSIS OF LOWER LIMBS.—Complete or partial; in latter case, flexors mainly affected. Of upper motor neuron type (spastic paraplegia)—viz., wasting only from disuse, and electrical reactions normal or diminished. Lower trunk may be affected, in which case umbilicus moves upwards on contracting abdominal muscles.
2. SENSORY CHANGES.—(a) *Anæsthesia*: usually to level of lesion, but light touch lost over smaller area than pain: upper limit definite or indefinite. (b) *Hyperæsthesia*: band common at upper level. Also *girdle pains*.
3. DEEP REFLEXES.—*Early* stages: diminished (flaccid). *Later*: spastic, knee-jerks increased, ankle-clonus and Babinski's sign present. *Superficial reflexes*: lost to level of lesion.
4. SPHINCTERS usually affected. Either: (a) Retention with overflow; or (b) Bladder empties periodically. May be unconsciousness of passage.
5. TROPHIC CHANGES liable to occur: œdema, bullæ, *bedsores*. Cystitis may develop from retention, catheterization, and infection of urine.

With a complete transverse lesion or a grave injury, all reflexes are lost, 'stage of flaccidity'. This may be permanent; but, in absence of sepsis, such stage of shock may be succeeded, in about three weeks, by a 'stage of reflex activity'; a slight stimulus will now produce violent spasms of limbs, trunk, bladder, etc., the so-called 'mass reflex' (Head and Riddoch).

PROGNOSIS.—Improvement variable in each group of symptoms. Complete recovery rare. Patient usually arrives at a stationary stage in condition of lateral sclerosis, with marked muscular rigidity, tendency to spasms, increased reflexes, but slight wasting or electrical changes. Recovery of sphincter control variable. *Contractions* of flexor muscles develop.

b. Cervical Myelitis.—Rare, except in trauma. Diaphragm often involved (phrenic nerve), with rapidly fatal result.

SYMPTOMS.—

1. LOWER LIMBS, REFLEXES, ETC.—Condition as in dorsal myelitis, *upper motor neuron paralysis*.
2. UPPER LIMBS.—*Lower motor neuron paralysis*—i.e., with *muscular wasting*, etc.
3. ANÆSTHESIA.—Lower limbs and trunk; in upper limbs depends on segment involved.

Transverse Myelitis—Cervical—Symptoms, *continued*.

4. SPECIAL SYMPTOMS may be present: pupil small (spinal myosis), slow pulse, vomiting, hiccup; occasionally hyperpyrexia.

c. **Lumbar and Lumbo-sacral Myelitis.**—Uncommon.

SYMPTOMS.—

1. WEAKNESS AND PARALYSIS OF LEGS.—Type, extent, and distribution vary with site of lesion: partly of upper and partly of lower motor neurons, but mainly of latter from destruction of anterior horn cells—whence: (a) *Atrophy of muscles*; (b) *Knee-jerks absent*, with ankle-clonus and Babinski's sign present.
2. SENSORY CHANGES.—Not above groin.
3. SPHINCTERS affected: urine dribbles (true incontinence).
4. TROPHIC CHANGES, *bedsores* and *cystitis*, are early and severe.

2. **Acute Ascending or Diffuse Myelitis.**—*Rare*. Onset and progress rapid; usually commences in legs.

SYMPTOMS.—

1. PARALYSIS AND ANÆSTHESIA, progressively ascending.
2. PYREXIA and constitutional symptoms from onset.
3. SPHINCTERS paralysed.
4. TROPHIC CHANGES.—*Rapid wasting, bedsores, and cystitis*.

DEATH.—Usually within 5 to 10 days.

ORIGIN.—Probably infective.

DIAGNOSIS.—Usually simple. From other acute progressive paralyses:—

1. LANDRY'S PARALYSIS: By *sensory, sphincter, and trophic changes, wasting, and pyrexia*.
2. ACUTE MULTIPLE NEURITIS: By *sphincter affection, completeness of anæsthesia, and absence of muscular pain*.

Rare Types.—

DISSEMINATED MYELITIS.—Brain and cranial nerves also affected. Scattered lesions and irregular symptoms.

DIFFUSE CENTRAL MYELITIS.—Rapid paralysis, anæsthesia, and trophic changes. Reflexes absent. Commences in arms or legs. Fatal.

Prognosis.—

GENERAL PRINCIPLES:—

1. No definite prognosis of amount of recovery can be given at onset. Improvement often rapid to a stage and then stationary. Complete recovery very rare.
2. Better when following some *definite* illness.
3. The greater the extent of the symptoms, the worse the prognosis.
4. *Anæsthesia*: a *sharp* upper margin and extension to level of lesion is worse than indefiniteness.
5. Best in *dorsal* myelitis. In *cervical* lesion, frequent fatal respiratory paralysis or disease. In *lumbar* lesion, sphincters and legs rarely recover: mortality high from *bedsores* and *cystitis*.

6. *Transverse type* better than diffuse and ascending.
7. High mortality in *bedsores* and *cystitis* (result in sepsis and pyelonephritis).

Diagnosis of Transverse Myelitis.—Usually easy. Characterized by: (a) *Paralysis and anæsthesia* up to a fairly definite level; (b) *Sphincters* affected; (c) *Increased reflexes* (exceptions noted above). X-ray of spine and Wassermann reaction important. Diagnosis from:—

I. CONDITIONS WHERE THE SYMPTOMS ARE DUE TO AN EXTRASPINAL CAUSE.—

- a. CEREBRAL LESIONS.—Excluded by bilateral nature and anæsthesia.
- b. ACUTE MULTIPLE NEURITIS.—Difficulty only in lumbosacral lesions. In neuritis: (i) Pain greater and muscles tender; (ii) Paralysis flaccid; (iii) *Anæsthesia* slighter, and corresponds to peripheral nerves and not segments; (iv) *Sphincters* unaffected (unless mental disturbance).
- c. HYSTERICAL PARAPLEGIA.—Other signs of hysteria; never an extensor plantar response; bilateral anæsthesia very rare. (May coexist with myelitis.)

Rarely:—

- d. DISSEMINATED SCLEROSIS.—Acute onset rare, and no anæsthesia.

e. LANDRY'S PARALYSIS.—See ASCENDING MYELITIS p. 934.

2. OTHER INTRASPINAL LESIONS.—

- a. SYPHILIS (see p. 985).—History, rash, etc.
- b. COMPRESSION OF CORD.—Local tenderness and deformity in back; slow onset; root symptoms often severe; X rays. In tumours, primary growth—e.g., breast.
- c. HÆMORRHAGE INTO CORD.—Very rare. Abrupt onset.
- d. INTRAMEDULLARY TUMOURS.—Onset slower and unilateral. Dissociated anæsthesia and Brown-Séquard's paralysis.
- e. SUBACUTE COMBINED DEGENERATION.—Anæmia. Reflexes absent. Slow onset.

Treatment.—*Special Indications:* (1) Prevent bedsores and cystitis; (2) Aid recovery of muscles and reduce contractures. Skilful nursing is essential.

ACUTE STAGE.—

1. REST IN BED, on water-bed. Frequent change of posture. Avoid burns from hot-water bottles.
2. SKIN kept absolutely dry and clean. If an area reddens, wash with spirit, dry, and dust with powder (zinc oxide and starch). Foment bedsores and treat as ulcers.
3. BLADDER.—(a) Retention: frequent catheterization, strictly aseptic; or 'expression of bladder'. (b) Incontinence: urinal. Parts must be kept perfectly clean, and wool packed round frequently. For cystitis, bladder washes and urotropine.
4. BOWELS regulated. Enema daily if necessary.

No local treatment to spine, or drug, is of proved value.

AFTER ACUTE STAGE (10 to 14 days).—

NOURISHING DIET. GENERAL TONICS: avoid strychnine if spastic.

Transverse Myelitis—Treatment, continued.

ENCOURAGE TO MOVE LIMBS.—Massage and movements.

REFLEX SPASMS.—Bathe with hot water; sedatives, phenacetin, bromides, etc.

CONTRACTURES.—Watch for and counteract by arranging position of limbs.

II. COMPRESSION OF THE SPINAL CORD.

(*Compression Myelitis.*)

Compression myelitis is a term applied to symptoms and lesions resulting from slow compression of the spinal cord.

Causes.—(1) *Tuberculous caries*: commonest cause. (2) *Fracture-dislocation* of spine: rapid. (3) *Tumours* of: (a) *Vertebræ*; (b) *Meninges* and roots; (c) *Cord*. (4) *Aneurysms* of descending aorta (rare). Very rarely: (5) *Spondylitis deformans*; (6) *Syphilitic caries*; (7) *Hodgkin's disease*; (8) *Pachymeningitis* (*P. cervicalis hypertrophica*). Occasionally: *Hydatid cysts* and *cisticercus*.

Symptoms.—Result from affection of: (1) *Vertebræ*; (2) *Nerve roots*; (3) *Spinal cord*.

1. **VERTEBRÆ.**—(a) *Local pain and tenderness*. (b) *Rigidity* of back. (c) *Deformity*. The pain is increased by jarring and movement: may be present before deformity.
2. **NERVE-ROOT SYMPTOMS.**—At level of the lesion. From compression or irritation in canal or foramina. *Pain and hyperæsthesia* in segments affected: often agonizing. Later there may be *anæsthesia* or *anæsthesia dolorosa* (i.e., pain felt over an anæsthetic area). Occasionally, atrophy of muscles from anterior-root affections. Rarely, *herpes zoster*.
3. **CORD SYMPTOMS** (*see TRANSVERSE MYELITIS*).—*Onset* usually very slow; rarely rapid, from: (a) *Vascular disturbances*—e.g., *œdema*; (b) *Inflammation*—i.e., true 'myelitis'.

Symptoms commence in lower limbs: a *spastic paraplegia*, as in transverse myelitis, characterized by: (a) *Weakness of legs* (earliest sign); (b) *Rigidity*; (c) *Increased knee-jerks* and deep reflexes; *Babinski's sign*. Also, but less marked than in myelitis: (d) *Sphincters* affected; (e) *Sensory changes* and *anæsthesia*. Final symptoms vary with level of lesion (*see TRANSVERSE MYELITIS*). *Bedsore*s not common.

ABSCESS FORMATION, *psaos* and *retropharyngeal*, in *tuberculous caries*.

Tuberculous Caries of Spine causing compression.—**ETIOLOGY.**—

AGE.—Usually childhood, may be later.

PREDISPOSING FACTORS.—*Tuberculosis* elsewhere, e.g., lungs. Occasionally history of injury. *Tuberculous family history* common.

MORBID ANATOMY.—Commences in bodies of one or more vertebræ; softening, caseation, and collapse follow, with resulting deformity. Tuberculous mass forms in vertebral canal, but rarely penetrates dura, and very rarely directly invades cord.

CAUSE OF COMPRESSION.—(1) *Tuberculous mass* in canal usual cause. Rarely: (2) Compression by bony deformity; (3) Abscess; (4) Myelitis from circulatory or inflammatory changes (rapid progress).

Actual destruction of nerve tissue uncommon (hence recovery on treatment).

The nerve roots are affected in the canal or intervertebral foramina.

SYMPTOMS.—

SPECIAL CHARACTERISTICS:—

1. *Vertebræ.*—*Deformity* usually sharp, with a prominent spine: generally long preceded by *local pain, tenderness, and rigidity*. Compression of cord by tuberculous mass in absence of deformity may occur, but rare.

2. *Cord Symptoms.*—Onset usually late. Increased knee-jerks earliest sign, followed by weakness of legs.

3. *Root Symptoms.*—Rarely severe, and often absent.

CERVICAL REGION.—Frequent in axis and atlas. Common symptoms: (1) Spasm of cervical muscles; (2) Sympathetic nerve affected, pupil dilated, etc. (3) Retropharyngeal abscess. Cord symptoms frequently absent. Recovery, with rigidity of neck and much callus.

THORACIC REGION.—Commonest site. Deformity and, later, cord symptoms common. Psoas abscess.

LUMBAR REGION.—Resembles above, but knee-jerks may be absent.

COURSE AND PROGNOSIS.—General principles:—

1. Children better than adults.
2. Severe myelitis may recover under treatment.
3. Dorsal lesions better than cervical or lumbar.
4. Bad with tuberculous lesions elsewhere.
5. Compression by bone serious.

TREATMENT.—Absolute rest. General treatment for tuberculosis: otherwise surgical. Treatment for 12 to 24 months.

Tumours of the Vertebræ.—

PATHOLOGY.—

1. **BENIGN.**—Very rare. Exostoses, chondromata, etc.

2. **MALIGNANT.**—(a) Carcinoma: Always secondary; primary growth commonest in *breast*, occasionally uterus, stomach, etc. (b) Sarcoma: Rare; primary or secondary. Extension to meninges or cord very rare. Compression of cord often absent, but roots affected in intervertebral foramina.

SYMPTOMS.

SPECIAL CHARACTERISTICS:—

1. *Root Symptoms.*—*Early and marked*: progresses to agonizing paroxysms, often on the slightest movement. Site varies with lesion. Later, anæsthesia or anæsthesia

Tumours of the Vertebrae—Symptoms, continued.

- dolorosa. Anterior roots less commonly affected; spasm or, later, atrophy of muscles.
2. *Vertebrae*.—Pain and tenderness usually severe. Deformity less angular than in caries (growth replacing bone). Growth may invade spinal muscles.
 3. *Cord Symptoms*.—Often absent. Onset may be slow or acute (vascular or inflammatory myelitis).

TREATMENT.—Laminectomy to relieve pressure on nerve roots. Morphia usually necessary. Course progressive.

Tumours of Spinal Cord and Membranes.—See p. 939.

General Diagnosis.—X-ray and Wassermann reaction important.

1. **TUBERCULOUS CRIES.**—Characteristics: (a) Local pain and tenderness over spine; (b) Rigidity; (c) Deformity, often prominent spine; (d) Increased knee-jerks. Also: (e) Root symptoms rarely severe; (f) Abscesses. Diagnosis is most difficult in absence of deformity.

DIAGNOSIS FROM:—

Tumours of vertebrae: Deformity less sharp; root symptoms early and severe; radiograph. Primary growth (breast); absence of tuberculosis. Age.

Aneurysm: Age; Wassermann reaction; physical signs.

Tumours of spinal meninges: Root symptoms earliest; symptoms unilateral at onset; distribution and progress; no deformity.

Spondylitis deformans: Age. Radiograph. Widespread rigidity.

Pachymeningitis: Usually cervical; root symptoms severe and of long duration before cord affected; bilateral; progress very slow.

2. **TUMOURS OF VERTEBRÆ.**—Characteristics: (a) Early root symptoms, increased by movement; (b) Vertebral pain and tenderness; (c) Deformity curved or absent; together with: (d) Primary growth, commonly in breast; (e) Rapid emaciation.

DIAGNOSIS FROM: Caries; aneurysm; tumours of meninges; and pachymeningitis. Also from biliary and other colics; neuralgia and neuritis, e.g., intercostal.

3. **TUMOURS OF MENINGES.**—Characteristics: (a) Symptoms commence unilaterally; (b) Root symptoms early; (c) Cord symptoms also unilateral—paralysis and root symptoms on side of lesion, with main sensory changes on opposite side (may be typical Brown-Séquard's paralysis); (d) Later, symptoms bilateral; (e) No deformity.

4. **CONDITIONS NOT INVOLVING COMPRESSION DEFORMITY.**—

DIAGNOSIS FROM:—

Hysteria and neurasthenia: Tenderness of spine not localized; no affection of sphincters; no Babinski's sign. In hysteria: distribution of anæsthesia 'stocking' or 'glove'; other hysterical signs.

Amyotrophic lateral sclerosis: No sensory changes.

Neuritis and neuralgias—e.g., *intercostal, sciatica, lumbago*:

Very difficult. Often by progress. X rays. Tenderness over nerve trunks.

DIAGNOSIS OF 'SPINAL BLOCK'.—See p. 940.

III. TUMOURS OF THE SPINAL MEMBRANES AND CORD.

Varieties.—(1) *Extramedullary* or *meningeal* tumours, viz., tumours of meninges and roots; (2) *Intramedullary* tumours, viz., tumours of cord. All rare, especially intramedullary.

For TUMOURS OF THE VERTEBRÆ, and for DIAGNOSIS, see COMPRESSION OF THE SPINAL CORD.

Note.—Symptoms vary greatly with the position and extent of the tumour.

1. **Extramedullary Tumours.**—Meninges and roots.

PATHOLOGY.—Usually on the dorsal or lateral surface. Two groups:—

a. **EXTRADURAL.**—

Origin.—Dura mater, vertebral periosteum, or intervening tissues.

Histology.—Most frequent: (i) Sarcoma; (ii) Hydatid cysts. Rarely: Lipoma, fibroma, etc. Sarcoma alone invades cord. Carcinoma very rare, always secondary.

b **INTRADURAL.**—Commoner.

Origin.—Dura mater, meninges, spinal roots.

Histology.—Most frequent: (i) Sarcoma, local or diffuse sarcomatosis; (ii) Fibrosarcoma or fibroma; (iii) Endothelioma. Rarely: Gumma, psammoma, lipoma, neurinoma, etc. About half are simple and removable.

SYMPTOMS.—*Unilateral*, usually, in early stages; later bilateral.

EARLY SYMPTOMS:—

1. *Pain in Back.*—Probably meningeal.

2. *Root Symptoms.*—Pain, hyperæsthesia in affected segments: subsequently often lost when roots destroyed.

LATER.—

3. *Cord Symptoms.*—Onset slowly from compression, or rarely rapidly from myelitis. Characteristics: (a) Sensory changes; (b) Spastic paralysis below segment; (c) Atrophic paralysis in affected segment. *Unilateral* position of growth results in: (i) On side of tumour: paralysis and root symptoms. (ii) On opposite side: anæsthesia: of variable extent, but involves all sensations—i.e., is not 'dissociated'. Sphincters affected; reflexes increased; Babinski's sign present. Later, bed-sores and cystitis common. Brown-Séquard's syndrome may be present typically, more often atypically (lesion not strictly unilateral).

Symptoms vary with position of tumour (see TRANSVERSE MYELITIS).

Tumours of the Spinal Membranes and Cord—Extramedullary, cont.

LOCALIZATION.—By area of root symptoms. Usually site is one segment above highest level of anæsthesia, but more accurately localized by minute sensory changes.

NATURE OF GROWTH.—Rarely ascertainable. Note rate of progress, primary tumours, Wassermann reaction.

PROGNOSIS.—*Malignant*: rapidly fatal. *Benign*: many successful operations.

TREATMENT.—*Laminectomy* on diagnosis: to remove growth, relieve pressure, or divide roots. If inoperable (e.g., other growths present), morphia. Palliative treatment as in myelitis. With positive Wassermann reaction, syphilitic treatment, but early laminectomy if no rapid improvement (three to four weeks).

DIAGNOSIS.—From caries, tumours of vertebræ, pachymeningitis, and conditions not involving compression (see COMPRESSION MYELITIS). From intramedullary tumours: in latter, root symptoms absent, dissociated anæsthesia.

2. Intramedullary Tumours.—Spinal cord.

PATHOLOGY.—Usually in cervical or lumbar regions.

Origin.—In cord (glioma), or more commonly invading from pia mater.

Histology.—(i) *Tubercle*—most common; (ii) *Glioma*, or gliosarcoma; (iii) *Sarcoma*; (iv) *Gumma*, very rarely. Degenerations common. Glioma usually commences in gray matter.

SYMPTOMS.—*Unilateral* until late.

1. *'Dissociated' Anæsthesia.*—Pain and temperature sense lost on side opposite to lesion; light touch retained.

2. *Spastic Paralysis* on side of tumour. Sphincters affected; deep reflexes increased, and Babinski's sign present. Brown-Séquard's paralysis present typically or atypically. In segment of tumour, atrophic paralysis.

3. *Root Symptoms and Pain.*—Absent or slight.

PROGRESS.—Slow. Symptoms later bilateral, as in transverse myelitis.

TREATMENT.—Palliative, unless syphilitic.

Summary of Symptoms.—

1. **EXTRAMEDULLARY.**—(a) Unilateral onset; (b) Root symptoms early and severe; (c) Anæsthesia of all sensations on opposite side; (d) Paralysis on side of lesion; sphincters and reflexes affected.
2. **INTRAMEDULLARY.**—(a) Unilateral onset; (b) Root symptoms absent or slight; (c) Dissociated anæsthesia on opposite side; (d) Paralysis on side of lesion; sphincters and reflexes affected. Typical Brown-Séquard paralysis may occur.

Diagnosis of 'Spinal Block'.—

1. **RADIOGRAPHY.**—After injection of lipiodol: (1) Ordinary lipiodol (heavy, sinking, 30 per cent iodine) by cisternal puncture, and (2) light ascending lipiodol (10 per cent iodine) by

lumbar puncture. Accumulates and forms shadow above and below block.

PARTIAL BLOCK.—Chronic meningitis; tumours.

COMPLETE BLOCK.—Extra- or intramedullary tumours.

2. **QUECKENSTEDT'S TEST (Manometry).**—Pressure of cerebro-spinal fluid measured by manometer, when breathing quickly. Normal: 120 mm. H₂O.

ABOVE OR IN ABSENCE OF 'SPINAL BLOCK'.—Pressure rises rapidly if jugular veins (try each separately) compressed: distends intracranial veins and pressure rises at once; falls rapidly on releasing pressure.

PARTIAL BLOCK—Slow rise and fall, or rise without fall.

3. **FROIN'S SYNDROME.**—Chemical examination of fluid from below block: (1) Fluid clear and slightly yellow, *xanthochromia*, from extravasation of blood. (2) Protein, 3 to 4 per cent (normal 0.02); (3) Cells absent or not in excess. May clot spontaneously. *Positive in:* (a) Tumours of cord and meninges, spinal caries; (b) Chronic meningitis. Possibly in polyneuritis and Landry's paralysis.

NOTE.—Froin did not describe this syndrome.

IV. SYRINGOMYELIA.

(*Gliosis or Gliomatosis of the Spinal Cord.*)

A chronic disease of the spinal cord, characterized pathologically by new growth of neuroglia (gliosis) near the central canal, and presence of a cavity, and clinically by dissociated anæsthesia, trophic changes, and muscular atrophy.

Etiology.—

AGE AT ONSET.—Usually 20 to 30 years.

SEX.—Commoner in males, 2 to 1 female.

NO HEREDITARY AND NO SYPHILITIC FACTOR.

TRAUMA.—Previous severe injury to head, spine, ribs not infrequent, but influence as factor still uncertain; possibly causes hæmorrhage.

CONGENITAL ABNORMALITIES occasionally present.

Morbid Anatomy.—

SPINAL CORD.—On section, two characteristic changes are found:—

1. **CAVITY** present. Usually posterior to central canal. *Size*, variable, from slit to most of transverse section. Often extends into anterior, and less often into posterior, horns. May communicate with central canal, and is then lined with ependymal cells. Occasionally two cavities, but if so they are connected at some level.
2. **GLIOSIS**, increase of neuroglia, around cavity. Of translucent gelatinous appearance, often blood-tinged. Consists of embryonic neuroglial tissue. Degeneration and hæmorrhage not infrequent.

The extent of these two changes, absolutely, and also relatively to each other, varies greatly. The cavity may extend up and

Syringomyelia—Morbidity Anatomy, *continued*.

down most of the cord. The *gliosis* may cover most of the section at certain levels, but the lateral white matter at the periphery is rarely affected. Vertically considered, the gliosis may extend beyond (above or below) the cavity, here forming a solid mass. In other cases the gliosis is limited to a small area surrounding the cavity. The lesions may extend into the bulb and 4th ventricle. Ascending and descending degeneration of affected tracts may occur.

SITE.—Commonest in lower cervical region; next in lumbar segments.

Pathogenesis.—Theories of origin include:—

1. A 'gliosis' or 'gliomatosis'—i.e., proliferation of neuroglia, with subsequent degeneration forming a cavity. Supported by invariable presence of some degree of gliosis.
2. A congenital defect, the cavity being remnant of an embryonic fissure. Supported by the occasional presence of other congenital defects, and by the embryonic nature of neuroglia.

Possibly both groups occur. Hæmatomyelia is improbable as a frequent origin.

Symptoms.—Result from destruction of nerve tissue and also from pressure on tracts, and hence vary greatly in extent and in combination of the three groups described.

ONSET.—Insidious. *Initial symptoms* noticed may be tingling and pains; frequently absence of pain following burns, cuts, etc.

THREE CHARACTERISTIC GROUPS OF SYMPTOMS.—(1) '*Dissociated anæsthesia*'; (2) *Trophic changes* in skin, joints, and other tissues; (3) *Muscular atrophy* and motor changes. Upper extremities and trunk most commonly affected.

1. **SENSORY CHANGES.**—'*Dissociated anæsthesia*', viz., loss of sensations of heat, cold, and pain, with retention of light touch. Limits sharply defined; distribution usually asymmetrical and irregular, corresponding to segments or parts of segments. Heat, cold, and pain equally affected; or, slightly, heat more than cold, and cold than pain. Due to injury to fibres while *crossing cord in anterior white commissure* (see p. 913).

2. **VASOMOTOR AND TROPHIC CHANGES.**—

Skin.—Thin and 'glossy', often sweating; hair on area diminished; nails furrowed and brittle. Extremities usually cold, occasionally hot and congested. Dermatitis, eruptions, and sepsis are common.

Joints.—*Arthropathies*. Sudden painless swelling and changes identical with Charcot's joints of tabes occur, but usually in shoulder, elbow, or wrist.

Spontaneous fractures occur rarely.

3. **MOTOR SYMPTOMS.**—*Muscular atrophy and paralysis*, of lower motor neuron type; commonly in sequence—small muscles of hand (with development of claw-hand), forearm, upper arm, shoulder, as in progressive muscular atrophy. Rarely,

commences in shoulder. *Spastic paraplegia* common, though rarely severe (pressure on pyramidal tracts); condition finally resembling amyotrophic lateral sclerosis. *Scoliosis* common, from muscular weakness.

SPHINCTERS and SPECIAL SENSES.—Rarely affected. Cervical sympathetic may be paralysed (small pupil, etc.).

OCCASIONAL VARIATIONS.—Onset in lower limbs, i.e., lumbar segments: extension from upper limbs very rare. Rarely, *medulla*, pons, and 4th ventricle affected, with dissociated anaesthesia of face and head, nystagmus, paralysis of cranial nerves, or bulbar paralysis (syringobulbia).

Types.—Schlesinger describes five: (1) *Classical type*: usual form. (2) *Motor tracts* mainly affected, resembling amyotrophic lateral sclerosis. (3) *Sensory tracts* mainly affected, resembling hysteria. (4) *Trophic changes* marked, viz., Morvan's disease. (5) *Tabetic type*: posterior columns affected, with tabetic changes in lower and syringomyelic changes in upper limbs.

MORVAN'S DISEASE (Painless Whitlows).—Marked trophic changes and dissociated anaesthesia in the extremities. Results in necrotic dactylitis. May also be sepsis. Is a type of syringomyelia.

Diagnosis.—Usually simple, from combination of dissociated anaesthesia, trophic changes, atrophic paralysis, and slow progress. Diagnosis from:—

SPINAL HÆMORRHAGE—Onset sudden; improvement follows. Close resemblance of symptoms.

INTRAMEDULLARY TUMOURS—Symptoms more unilateral; progress rapid.

ANÆSTHETIC LEPROSY.—Nerves thickened; loss of tissues.

HYSTERICAL ANÆSTHESIA.—Onset sudden; no dissociation; 'glove' or 'stocking' distribution; never an extensor plantar reflex.

TABES (from lumbar syringomyelia).—Argyll Robertson pupil; no muscular atrophy; cerebrospinal fluid and Wassermann reaction.

ERYTHROMELALGIA.—Occasionally simulated in trophic forms. Dissociated anaesthesia distinguishes from many conditions of wasting, etc.—e.g., progressive muscular atrophy, cervical ribs, pachymeningitis cervicalis.

Course and Prognosis.—Progress very slow; may be arrested for many years. Rarely, rapid advance from hæmorrhage into cord. Death from bedsores, sepsis, or intercurrent affections. Prognosis worse in lumbar forms.

Treatment.—Protect from injury to anaesthetic parts. Improvement claimed from X-ray treatment, not fully confirmed.

V. LESIONS OF THE CAUDA EQUINA AND CONUS MEDULLARIS.

Anatomy.—The *conus medullaris* commences, arbitrarily, at upper border of 2nd lumbar vertebra, and terminates above its lower border. The *cauda equina* contains the 2nd lumbar and lower nerves until their exit at various levels.

Lesions of the Cauda Equina and Conus Medullaris, *continued*.

Etiology.—

1. FRACTURE of vertebræ or sacrum: may be hæmorrhage, Common cause.
2. TUMOURS of roots or membranes (usually neurofibroma), or bone.

Rarely :—

3. GUMMATOUS MENINGITIS.

Lesions of Cauda Equina.—

SYMPTOMS.—Vary with site and nerves affected; often *asymmetrical*. General characteristics :—

1. ANÆSTHESIA.—‘Saddle-shaped’ area in gluteal region; perineum; scrotum; urethra.
2. PAIN in nerve areas.
3. PARALYSIS of lower motor neuron type—i.e., flaccidity, rapid wasting, reflexes absent, etc. Usually below knee and in buttocks.
4. SPHINCTERS PARALYSED.—Bladder and rectum incontinent.
5. SEXUAL POWER LOST.

Lesions of Conus Medullaris.—Resemble lesions of lower portion of cauda equina below 2nd sacral nerves—i.e., reflexes present, and muscles below knee escape—but part of the cauda equina is usually involved simultaneously. The anæsthesia may be ‘dissociated’, but pain is usually slight.

Diagnosis.—By signs of injury; distribution of sensory and motor changes. From sciatica, by affection of sphincters and bilateral symptoms. With tumours, lumbar puncture gives dry or bloody tap.

Treatment.—Surgical, unless syphilitic.

VI. HÆMATOMYELIA.

(*Spinal Hæmorrhage*.)

Hæmorrhage into the spinal cord is rare.

Varieties.—(1) *Primary*; (2) *Secondary*.

1. PRIMARY HÆMORRHAGE.—

ETIOLOGY.—

Age.—All ages, usually 20 to 40 years.

Sex.—Males commonest.

Injury usual cause, especially to neck; neither fracture nor injury to meninges invariable; occasionally in infants during labour.

Hæmophilia, extreme anæmia, violent muscular exertion, are rare causes.

Rarity, compared with cerebral hæmorrhage, due to length and tortuosity of arteries diminishing effects of high blood-pressure.

PATHOLOGY.—Hæmorrhage commences in gray matter (from vascularity); may be limited to it, and often unilateral, but extent varies; spreads vertically rather than transversely; commonest in cervical and lumbar regions. Subsequent changes as in other hæmorrhages—viz., scar formation, cavities, and cysts. Surrounding myelitis common.

2. **SECONDARY HÆMORRHAGE.**—Into areas of *myelitis*, *tumours*, or *syringomyelia*, producing sudden symptoms. *Minute petechial hæmorrhages* occur in tetanus, eclampsia, rabies, and other severe convulsions, and rarely in extreme venous congestion; but symptoms are due to primary disease, and condition is not clinically hæmatomyelia.

Symptoms.—

AT ONSET.—*Sudden paralysis*, or occasionally rapid development to a maximum. Consciousness usually retained. Root pains rarely severe. May be marked hyperæsthetic area and pains in back. Initial anæsthesia complete, or dissociated anæsthesia and Brown-Séquard's syndrome from onset.

Symptoms vary with extent and site as in other spinal lesions. Complete transverse lesion frequent, with complete sensory and motor paralysis, absence of reflexes, paralysis of sphincters, and hyperæsthesia in affected segment.

CERVICAL REGION.—All limbs affected, also abdominal and thoracic muscles, whence diaphragmatic breathing only.

DORSAL REGION.—Arms escape

LUMBAR REGION.—Flaccidity *permanent*; rapid atrophy; sphincters incontinent.

SUBSEQUENT CONDITION.—(1) *Atrophic paralysis* in affected segments; (2) *Spastic paralysis* in lower segments, with increased reflexes and Babinski's sign; (3) *Dissociated anæsthesia*; (4) *Sphincters* paralysed. (5) Trophic changes, bedsores and cystitis. Sensory and motor symptoms below lesion may be unilateral (producing Brown-Séquard's syndrome) or bilateral.

CEREBROSPINAL FLUID.—At onset normal; later, often yellow from bile pigment.

Diagnosis.—From :—

MENINGEAL HÆMORRHAGE.—By sudden paralysis, dissociated anæsthesia, and absence of root pains and muscular spasms.

SYRINGOMYELIA.—Symptoms often identical, but onset slow and condition progresses, while hæmorrhage improves.

ACUTE MYELITIS.—Premonitory symptoms; less rapid onset; pyrexia.

Course and Prognosis.—*Rapid death* common, especially from respiratory paralysis. *Improvement* otherwise considerable, with varying degrees of residual symptoms (see 'Subsequent Condition' above). Cystitis or bedsores may be fatal.

Treatment.—Absolute rest. Ice-bag to spine. Laminectomy contra-indicated. General treatment as in myelitis.

VII. HÆMATORRHACHIS.

(Meningeal Hæmorrhage.)

Meningeal hæmorrhage of the cord is very rare.

Varieties.—

1. EXTRADURAL.—Commonest form. From spinal injuries. Rarely, aortic aneurysm.
2. INTRADURAL.—(a) Fractured base of skull; (b) Ruptured vertebral or basilar aneurysms; (c) Spinal injuries. Very rarely from: (d) Hæmophilia, purpura, etc.; (e) Hæmorrhagic fevers, e.g., small-pox; (f) Tetanus, eclampsia, and severe convulsions; (g) Extreme venous congestion.

Symptoms.—With moderate degrees, symptoms slight. When severe: (1) Onset sudden; (2) Severe pains in back (meningeal); (3) Severe pain and hyperæsthesia in root areas; (4) Paræsthesia in limbs; (5) Involuntary muscular spasms; rigidity of back. No loss of consciousness, no pyrexia, but often much shock.

Paralysis of limbs, anæsthesia, affection of sphincters, of varying degree, may develop either rapidly or less suddenly, and especially in lower segments, from gravitation of blood. Symptoms vary with extent and level of hæmorrhage.

Diagnosis.—(See HÆMATOMYELIA, above.) From *spinal meningitis*, by sudden onset and absence of pyrexia. Presence of blood in cerebrospinal fluid is of diagnostic importance in fractured base.

Course and Prognosis.—Mortality high, from hæmorrhage, or other injuries, or respiratory paralysis. Prognosis improves after few days, but recovery never complete. May be death from bed-sores or cystitis.

Treatment.—Absolute rest. Ice-bag to spine. Morphia for pain. *Laminectomy* urgently indicated by signs of compression and increasing hæmorrhage. General treatment as in myelitis.

VIII. LANDRY'S ACUTE ASCENDING PARALYSIS.

An acute ascending flaccid paralysis commencing in the legs and rapidly extending to the trunk, arms, and diaphragm. No sensory, electrical, sphincter, or mental changes, and no wasting. Reflexes lost. No pathological changes.

Note 1.—Few conditions are more in dispute. Some authorities include cases with sensory changes or with various gross pathological changes in cord or nerves. Such forms, undoubtedly occurring, become intermediate with acute polyneuritis, poliomyelitis, and ascending myelitis. They are not included in this description.

The *pathogenesis* also is obscure. Obviously it is an affection of the lower motor neuron. Landry described the march of the paralysis as legs, arms, trunk—i.e., commencing generally from periphery, and suggesting a toxic multiple neuritis ascending the nerves and finally affecting the cord: a view widely held. But most clinicians consider the order to be legs, trunk, arms—i.e., a process ascending the cord. No unimpeachable organism discovered.

Note 2.—Landry's is not the only form of acute ascending paralysis.

Etiology.—

AGE.—Commonest 20 to 30 years.

SEX.—Males most frequent.

PREDISPOSING FACTORS.—Often none, patient previously in good health; occasionally alcoholism, infectious fevers, exposure.

Symptoms.—

ONSET of paralysis sudden. Occasionally *premonitory symptoms* for hours or days or more—e.g., paræsthesias, various pains, or weakness. Paralysis commences in lower extremities, at or near periphery, and progressively ascends in order: (1) Legs; (2) Trunk; (3) Arms (commencing at periphery); (4) Diaphragm; and, if surviving, (5) Cranial nerves.

DURATION OF PROGRESS.—A few hours to a few days.

PARALYSIS *flaccid*. All reflexes lost, deep and superficial. No atrophy or electrical changes. No sensory, sphincter, or mental changes. No pain. Pyrexia absent or slight. Trophic changes not marked. Spleen occasionally recorded as palpable.

VARIATIONS AND ATYPICAL FORMS frequently recorded, with varying degrees of sensory changes, tenderness in nerves, etc. (see Note 1 above). Paralysis may commence in arms, rarely.

Diagnosis.—Difficult from other forms of acute and ascending paralysis.

ACUTE MULTIPLE NEURITIS.—Pain; tender muscles and nerve trunks; sensory changes; early wasting; abdominal reflexes present. Mortality low.

ACUTE ASCENDING MYELITIS.—Marked sensory changes; sphincters affected; pyrexia. Mortality very high.

ACUTE ANTERIOR POLIOMYELITIS.—Severe constitutional symptoms; paralysis rarely complete; no sensory changes, but often pain on movement; rapid atrophy.

Course and Prognosis.—Death from respiratory paralysis. Apparently typical cases have recovered, and then often completely. In later stages muscles waste.

Treatment.—Maintain general strength. Injections of strychnine. Artificial respiration and inhalation of oxygen when respiration failing. During recovery, treatment as in myelitis.

IX. DISSEMINATED SCLEROSIS.

(*Multiple Sclerosis. Insular Sclerosis.*)

A chronic disease of the nervous system, characterized pathologically by areas of sclerosis irregularly scattered, and clinically by symptoms of spastic paraplegia and by nystagmus, intention tremor, and scanning speech. Not uncommon.

Etiology.—

AGE AT ONSET.—Commonly 15 to 30 years; very rarely recognized under 12 years.

SEX.—Sexes equally affected.

PREDISPOSING FACTORS.—Doubtful. Not hereditary, very rarely familial. No syphilitic factor.

Disseminated Sclerosis, *continued*.

Morbid Anatomy.—*Areas of sclerosis* scattered irregularly through brain and spinal cord; peripheral nerves not exempt. *White matter* mainly affected, but frequent in basal ganglia. *Outline* of area definite, *shape* irregular, *size* variable (up to a pea, rarely larger). Recent areas soft and translucent, old areas firm. *No ascending or descending degeneration* from the areas; reason doubtful; sometimes ascribed to persistence of axis cylinders, but many are destroyed in later stages.

HISTOLOGY OF AREAS OF SCLEROSIS.—(1) *Myelin sheaths of nerve fibres absent but axis cylinders present* (in later stages may degenerate); (2) Proliferation of neuroglia.

Pathogenesis entirely unknown. Most commonly believed that degeneration of myelin sheath is initial change, and due to toxin of autogenous origin.

Symptoms.—

SUMMARY (a 'spastic paraplegia' with certain special symptoms).—

- (1) Weakness and rigidity, especially in lower limbs;
- (2) Deep reflexes increased, with Babinski's sign;
- (3) Visual disturbances and optic atrophy;
- (4) Sphincters affected; together with Charcot's triad, viz.:
- (5) Intention tremor;
- (6) Nystagmus;
- (7) Scanning speech.*

MODES OF ONSET AND INITIAL STAGES.—

ONSET may be with *transient* attacks of either: (1) Weakness in limbs and paralyzes, commonest; (2) Paræsthesias—numbness and tingling; (3) Tremors or ataxia; (4) Visual disturbances.

THE INITIAL STAGES (often many years) are characterized by: (1) Great variability of symptoms; (2) Transient symptoms and prolonged remissions. Attacks occur resembling (a) hysteria, (b) 'influenza'. Thus, e.g., paralysis of one leg of sudden onset disappears suddenly or gradually, and after a long interval paralysis of an arm occurs.

THE CONDITION PROGRESSES, recovery from attacks becomes less complete, and various characteristic symptoms develop, or are found on examination.

CONSIDERATION OF SYMPTOMS IN DETAIL.

1. **MOTOR PHENOMENA.**—Invariably present; may advance to complete disability. Lower limbs most affected. In earlier stages, *transient paralyzes*. *Spastic paraplegia* gradually develops, with weakness and rigidity; *wasting* uncommon until late stages. *Inco-ordination* variable. *Contractures* occur late. Sudden muscular spasms may be troublesome. *Gait* as in spastic paraplegia or spastic ataxia: patient drags feet; is unsteady; walks with difficulty, on wide basis.

* Characteristic as 5, 6, and 7 may be, the absence of one or even all is far from uncommon, especially in the spinal form, even when the history of the disease can be traced back for many years; and such absence does not negative a diagnosis duly supported by other reasons.

2. TREMOR.—Characteristic '*intention tremor*', viz.: (a) Cessation at rest; (b) Occurs during voluntary movement, increasing in severity as movement continues. In *hand-writing*, revealed early: marked at end of a sentence. Usually in arms only.
Theories of Origin.—(i) Charcot: Axis cylinders are not properly insulated, and conduction of impulses is irregular. (ii) Erb: Areas of disease in certain sites disturb the mechanism for co-ordination of movement.
May be absent throughout, or coarse tremors present.
3. OCULAR PHENOMENA.—Important.
 - a. *Nystagmus*.—Bilateral; usually lateral. Present in 50 to 70 per cent.
 - b. *Primary Optic Atrophy*.—Mainly pallor of temporal half of discs. In 50 per cent. No retinitis or optic neuritis (*see also* OPTIC ATROPHY, p. 989). Affects vision, but complete blindness rare. (Cf. TABES.)
 - c. *Visual Disturbances*.—Common. Often transient. Transient amblyopia or diplopia common, but obvious ocular palsy rare.
 - d. *Fields of Vision*.—May be irregular contraction or central scotoma, often for colour only.
 - e. *Pupil*.—Reactions normal.
4. SCANNING SPEECH.—Syllables separated and staccato. Characteristic, but often absent. Minor changes common—e.g., monotonous tone.
5. REFLEXES.—
 - a. *Deep reflexes greatly increased*—knee, ankle, elbow, wrist, occasionally jaw.
 - b. *Ankle-clonus* present, true or 'spurious'.
 - c. *Extensor plantar response, Babinski's sign*. Superficial abdominal reflexes lost early.
6. SPHINCTERS affected. Early: difficult or '*precipitate*' micturition. Later: incontinence.
7. SENSORY PHENOMENA.—Numbness and tingling common. Sensory changes slight or indefinite; mainly in legs.
8. PSYCHICAL CHANGES.—Patient often emotional. Mental change very rare: may occur late in rare cerebral forms.
9. CEREBROSPINAL FLUID.—Lange's colloidal gold reaction may give weak paretic curve. Wassermann negative.
 Trophic changes in skin, nails, etc., occasionally. Sexual power diminishes. Epileptiform seizures extremely rare.

Types.—

1. SPINAL.—Spinal symptoms marked, resembling closely spinal diseases—e.g., (a) primary lateral sclerosis—i.e., a spastic paraplegia; (b) degeneration of postero-lateral columns—i.e., spastic ataxia (less common). Charcot's triad may be absent throughout.
 2. CEREBROSPINAL.—Both spinal and cerebral symptoms, producing classical syndrome.
 3. CEREBRAL.—Rare. Marked headache, giddiness, etc., and, later, psychical changes.
- ATYPICAL CASES are very common.

Disseminated Sclerosis, *continued*.

Diagnosis.—Note: (1) History of transient pareses, etc., and marked remissions; (2) Presence of characteristic symptoms, especially Babinski's sign, and the triad, nystagmus, intention tremor, and scanning speech; but absence of latter does not exclude diagnosis. Diagnosis from:—

1. HYSTERIA.—In early stages differentiation difficult, and *may coexist*. Note Babinski's sign, optic atrophy, and Charcot's triad.
2. TABES, DEMENTIA PARALYTICA, AND SYPHILIS OF NERVOUS SYSTEM.—Note especially: (a) Pupil changes; (b) Wassermann reaction; (c) Cerebrospinal fluid.
3. SUBACUTE COMBINED DEGENERATION.—Later onset; anæmia; sensory changes; absent knee-jerks.

Also from:—

CEREBELLAR DISEASES, COMPRESSION OF SPINAL CORD (tumours, caries), FRIEDREICH'S ATAXIA.

Course and Prognosis.—Commonly there is a long initial stage, insidious and deceptive, and a chronic course characterized by remissions. Less commonly, steadily progressive. In the final stages: exhaustion, cystitis, bedsores, bulbar paralysis, or inter-current disease.

DURATION.—Longest in *spinal* type: up to 20 years, or even average life-time. Shortest in *cerebral* type: may be 1 to 2 years.

Treatment.—Palliative treatment is important. Good food, fresh air, and exercise, but avoid all fatigue. (Worse in cold, wet, and winter.) Massage and passive movements useful; electricity contra-indicated.

DRUGS.—Arsenic beneficial. Mercury, iodides, and silver nitrate doubtful. Strychnine contra-indicated.

PREGNANCY undoubtedly bad.

(Rare Varieties of Sclerosis, usually with dementia.—*Tuberose sclerosis*; *Diffuse sclerosis*. Also *Pseudo-sclerosis*.)

X. HERPES ZOSTER.

(*Zona*.)

An acute affection characterized clinically by erythema, vesicles, and pain in the cutaneous area corresponding to one, or rarely two, dorsal roots, and pathologically by inflammation of dorsal root ganglia.

Etiology.—

1. IDIOPATHIC.
2. SYMPTOMATIC.—Precipitating factors: (a) Poisons—e.g., arsenic, bismuth; (b) Infections—e.g., cerebrospinal fever, syphilis; (c) Lesions of peripheral nerves, posterior root ganglia, and cord.

Virus.—Disease is ascribed to a virus. Characteristics :—

1. Infectious (epidemics occur).
2. Not transmissible to animals—i.e., neurotropic in man but not in animals.
3. No relation to herpes simplex.
4. No relation to encephalitis.
5. Symptomatic cases attributable to virus being enabled to act by 'precipitating factors'.
6. Chicken-pox may follow contact with case of zoster (converse rare).

Pathology.—Acute hæmorrhagic inflammation of dorsal root ganglia (Head and Campbell).

Symptoms.—

ONSET.—Malaise and pain ; slight pyrexia.

ERUPTION.—Commences with erythema about third day, then formation of vesicles. Commonest on trunk and unilateral. Distribution : area supplied from a dorsal root (partial or complete). On face, common in area of ophthalmic division of trigeminal nerve ('partial' fifth).

PAIN.—Precedes eruption ; often severe.

OCCASIONALLY.—*Lymphatic glands* enlarged, especially in axilla. Sensory changes, slight and variable. Paresis rare—e.g., abdominal muscles with corresponding segments.

HERPES OF GENICULATE GANGLION.—*Vesicles* in external auditory meatus ; may also be on fauces. *Pain* in same sites and mastoid. *Facial palsy*. Loss of taste over anterior two-thirds of tongue.

Sequela.—*Post-herpetic neuralgia*, occasionally very severe in old people.

Treatment.—*Local*: simple ointment. Pain may need morphia. For subsequent neuralgia, if severe : section of posterior spinal root.

HERPES SIMPLEX OR LABIALIS.*

Commonly exhibited by bunch of vesicles on lips, nostrils, or genitalia in association with a febrile condition.

Virus.—Characteristics :—

1. Infectious (contagious).
2. Transmissible to animals by conjunctival inoculation : results in encephalitis, transmissible in series. Thus is neurotropic in animals.
3. Present probably in normal saliva. Acute infections lower resistance and allow it to act.

RELATION TO ENCEPHALITIS LETHARGICA.—Transmission of this disease to animals is not proved, and identity with herpes simplex virus cannot be established, but is suggested.

* Considered here for convenience.

CHAPTER CLXVI.

SYSTEM DISEASES OF THE SPINAL CORD.)

I. SPASTIC PARAPLEGIA.

(Lateral Sclerosis.)

Loss of power and spasticity in the legs, due to lesions or degeneration of upper motor neurons, with absence of affection of other tracts.

Theoretically, a bilateral lesion may occur at any site; but in adults it is practically always in the cord, i.e., the lateral pyramidal tracts; in children it may be in cord or cortex—e.g., Little's disease.

Occurrence.—

1. PRIMARY FORMS.—(1) *Primary lateral sclerosis*; (2) *Hereditary spastic spinal paralysis*; (3) *Erb's syphilitic spinal paralysis*.

Note.—In the last two groups, other tracts are usually involved—e.g., posterior columns (postero-lateral sclerosis)—hence the condition is not a pure lateral sclerosis; the occurrence of a pure primary lateral sclerosis is still doubtful.

2. SECONDARY FORMS.—Occurs as initial clinical phenomenon in numerous spinal lesions, especially: (1) *Disseminated sclerosis*; (2) *Transverse myelitis from compression*—e.g., caries, tumour, fracture. Less commonly in: (3) *Amyotrophic lateral sclerosis*; (4) *Syphilitic chronic meningomyelitis*. Rarely: (5) *Dementia paralytica*; (6) *Cerebral tumours in pons, etc.* Closely simulated in (7) *Hysterical spastic paraplegia*.

Upper Motor Neuron Lesions.—*Characteristics* are: (a) Loss of power in muscles supplied; (b) Rigidity; (c) Increased reflexes; (d) Absence of wasting; (e) Absence of sensory changes, electrical changes, and affection of sphincters; (f) Babinski's extensor plantar reflex.

Symptoms of Lateral Sclerosis.—

1. INITIAL SYMPTOMS.—(a) Weakness of legs; easily tired. (b) Rigidity and stiffness. May be aching in back.
2. CONDITION DEVELOPED.—(a) *Weakness and rigidity of legs*. (b) *'Spastic gait'*: legs dragged stiffly, due to combination of weakness and rigidity preventing raising. (c) *Spasm of adductors of thighs*: legs close together, may be crossed, separated with difficulty. (d) *Deep reflexes increased*: knee-jerks exaggerated, ankle-clonus present, plantar reflex extensor. (e) No wasting; no sensory, electrical, or sphincter changes. Cramps and spontaneous spasms in muscles often troublesome.

Diagnosis.—From:

1. DISSEMINATED SCLEROSIS.—Examine for nystagmus, tremors, and alterations in speech.
2. TRANSVERSE MYELITIS.—Sensory changes, signs in back (caries, etc.).

3. **AMYOTROPHIC LATERAL SCLEROSIS.**—Wasting and weakness in upper limbs.
4. **HYSTERIA.**—Often very difficult. Usually wasting. Ankle-clonus 'spurious' (but this also occurs in early organic lesions). Other signs of hysteria: anæsthesia, fields of vision, etc.
5. **SYPHILIS.**—Wassermann reaction.
Also examine for signs of lesions of posterior columns (*ataxic paraplegia*).

1. PRIMARY LATERAL SCLEROSIS.

(*Erb's Spastic Spinal Sclerosis.*)

Symptoms of spastic paraplegia due to primary degeneration of lateral pyramidal tracts in cord, of spontaneous origin, and without affection of other tracts.

The occurrence of such a clinical entity is still doubtful; some chronic cases are on record, but most examples are subsequently proved to be *secondary spastic paraplegia*, or to have other tracts (e.g., posterior columns) involved; most frequently it is onset of a disseminated sclerosis.

Etiology.—

AGE AT ONSET.—20 to 45 years.

PREDISPOSING CAUSES.—Possibly cold, wet, injury to spine.

Symptoms.—*See above.* Arms may also become affected, and jaw-jerks and arm-jerks be present.

Diagnosis.—Justified only after many years.

Progress.—Slow; may be arrested; or finally patient may be bed-ridden, and death occur from intercurrent disease.

Treatment.—Exercise without fatigue beneficial. For spasms: hot baths, sedatives.

2. HEREDITARY SPASTIC SPINAL PARALYSIS.

(*Familial Spinal Paralysis.*)

A very rare familial disease in which spastic paraplegia develops, usually commencing in early life.

Etiology.—Markedly *familial*, but rarely *hereditary*. Both sexes, boys commoner. Transmitted by either sex. Onset usually 7th to 15th year; in a later group between 20 and 30 years.

Morbid Anatomy.—Degeneration of lateral pyramidal tracts, mainly in lower segments. Goll's columns may be affected, and direct cerebellar tracts.

Symptoms.—*Initial symptoms:* stiffness of legs and clumsiness in walking. *Progress* very slow. Complete spastic paraplegia develops. Arms may be affected late. Face escapes. Rarely late sensory and sphincter changes. Mental condition normal. Intermediate and atypical types of familial disease connect with Friedreich's ataxia and hereditary cerebellar ataxia. Diagnosis also from cerebral palsies, caries of spine, and myelitis.

3. ERB'S SYPHILITIC SPINAL PARALYSIS.

Etiology.—A rare syphilitic lesion. *Age at onset*: 20 to 40 years. Commoner in males. Usually two to five years from infection.

Morbid Anatomy.—Incomplete transverse myelitis in lower dorsal region, with secondary degeneration in lateral and posterior columns.

General Characteristics.—

ONSET very gradual: difficulty in walking, retention of urine, pain in back.

SPASTIC PARESIS of legs develops, rarely complete.

REFLEXES increased, but rigidity not extreme. Ankle-clonus and extensor plantar reflex.

SENSORY CHANGES: some girdle pains, paræsthesia, and loss of temperature sense.

SPHINCTERS affected.

IMPROVEMENT WITH TREATMENT: complete recovery rare.

II. ATAXIC PARAPLEGIA.

(*Postero-lateral Sclerosis and Hereditary Ataxia.*)

'Ataxic paraplegia' (Gowers) results from combined disease of posterior and lateral columns, including pyramidal and cerebellar tracts. This is not an entity and many conditions fall into the group: differentiation and classification difficult.

Postero-lateral Sclerosis.—Occurs in: (1) Primary ataxic paraplegia (possibly—*see below*); (2) Friedreich's ataxia; (3) Spino-cerebellar ataxia; (4) Subacute combined degeneration of the cord; (5) Syphilis, e.g., Erb's syphilitic spinal paralysis (*see SPASTIC PARAPLEGIA*). Also in pellagra and ergotism.

Hereditary and Familial Ataxias.—Include: (1) Friedreich's ataxia; (2) Spino-cerebellar ataxia (Sanger Brown, ? Marie's); (3) Primary progressive cerebellar degeneration and olivo-ponto-cerebellar atrophy (*see p. 1040*); (4) Hereditary spastic spinal paralysis (*see p. 953*). Other rare forms are described.

PRIMARY ATAXIC PARAPLEGIA.

Occurrence of pure postero-lateral sclerosis as a primary disease is doubtful, as is primary lateral sclerosis; most cases with an apparently pure syndrome prove to be disseminated sclerosis or subacute combined degeneration.

Symptoms.—Combination of *ataxia* and *spastic paraplegia*, constituting '*spastic ataxia*'.

ONSET in legs, with stiffness, unsteadiness, and rapid fatigue; then arms affected.

FRIEDREICH'S ATAXIA.

(*Hereditary Ataxia.*)

A chronic disease commencing in early life, characterized pathologically by degeneration of the posterior and lateral columns, and clinically by inco-ordination, absence of knee-jerks, nystagmus, alteration in speech, and deformities.

Etiology.—

AGE AT ONSET.—Usually 2 to 10 years, and up to, but rarely after, puberty.

HEREDITARY FACTORS.—Commonly *familial*, but less frequently hereditary; transmitted by either sex. Sporadic cases not uncommon. Consanguinity and alcohol in parents sometimes recorded. Syphilis, no proved influence.

SEX.—About equal.

Morbid Anatomy.—

SPINAL CORD distinctly small—probably congenital. Sclerosis of extensive distribution in: (1) *Posterior columns*; (2) *Lateral columns*, including (a) pyramidal tracts, (b) cerebellar tracts, both direct and Gowers', (c) Clarke's column (whence direct cerebellar tract arises); also in anterior pyramidal tracts. Lower segments most affected.

Cerebellum, medulla, and pons normal, or very slight changes.

Congenital pulmonary stenosis or early myocarditis not uncommon.

Pathogenesis.—Probably congenital early atrophy of nerve tissue (Gowers' 'abiotrophy').

Symptoms.—

ONSET insidious and progress slow, but familial nature may result in early recognition. Commences in legs; arms often soon affected.

EARLIEST SYMPTOMS.—Clumsy and unsteady walking. Also changes in feet and absence of knee-jerks.

CHARACTERISTIC SYMPTOMS.—

1. **ATAXIA OR INCO-ORDINATION.**—In voluntary movements—e.g., picking up pin—oscillating movements of limb terminate with a sudden pounce. Romberg's sign either present or absent.
2. **GAIT** irregular, swaying like a drunkard; feet wide apart, but no stamp as in tabes.
3. **TREMORS AND IRREGULAR MOVEMENTS**, nodding or swaying, of head and trunk.
4. **REFLEXES LOST EARLY:** knee-, Achilles-, and arm-jerks. *Extensor plantar reflex.*
5. **NYSTAGMUS** (lateral) usually early, but not invariably present.
6. **SPEECH** altered: slow, slurred, explosive, and syllables clipped. Due to ataxia of muscles of speech.
7. **DEFORMITIES.**—(a) *Feet:* Early onset; pes cavus (foot shortened and arch raised) and hammer-toes; great toe hyperextended. (b) *Scoliosis.*
8. **APPEARANCE.**—Dull. Mental powers slow, but otherwise unaffected until late.
9. **WEAKNESS OF MUSCLES** SLIGHT until later stages, but finally extreme.
10. **SENSATION** usually normal: may be slight late changes. No pain.
11. **PUPILS** normal.

Friedreich's Ataxia—Characteristic Symptoms, *continued*.

12. SPHINCTERS normal.
13. ELECTRICAL REACTIONS usually normal.
14. CRANIAL NERVES unaffected.

Clinical Variations are common: nystagmus may be absent, knee-jerks rarely may be present. *Spino-cerebellar ataxia* has been separated as a special type.

Diagnosis.—Often simple, from early age of onset, familial character, and symptoms. Diagnosis from:—

TABES.—Distinguished therefrom by: tremors, nystagmus, speech, deformities, absence of lightning pains and pupil changes; also negative Wassermann reaction. The very rare juvenile tabes needs care.

DISSEMINATED SCLEROSIS.—Distinguished therefrom by deformities, absent knee-jerks.

Occasionally confused with:—

CHOREA (knee-jerks increased), HUNTINGTON'S CHOREA, PROGRESSIVE NEURAL MUSCULAR ATROPHY.

Course.—Very slowly progressive. Walking becomes impossible. Later, completely bedridden, but may live many years subsequently.

Treatment.—Palliative. Massage, electricity, Frenkel's method (*see* TABES DORSALIS, p. 979).

SPINO-CEREBELLAR ATAXIA.

(*Sanger Brown's Ataxia.*)

Etiology.—*Familial and hereditary. Onset usually 17 to 35 years. Sexes equal. Very rare.*

Morbid Anatomy.—Degeneration of spino-cerebellar tracts, especially in dorsal tract (Flechsig), partially of posterior columns; pyramidal tracts escape. Cerebellum unaffected.

General Characteristics.—(1) *Inco-ordination*, of cerebellar type; earliest in legs. (2) *Gait reeling*. (3) *Knee-jerks increased*; flexor plantar reflex. (4) *Optic atrophy*, with failing sight, common; also ocular palsies, ptosis, etc. (5) *Speech*, as in Friedreich's ataxia. (6) *No deformities*. (7) Nystagmus not common. Slowly progressive, but life often long.

The condition is closely allied to Friedreich's ataxia, but note: (1) Stronger hereditary factor; (2) Later onset; (3) Presence of knee-jerks; (4) Presence of optic atrophy and ocular palsies; (5) No deformities; (6) Plantar reflex flexor.

Marie's Hereditary Cerebellar Ataxia.—Probably late cases of Friedreich's ataxia. Cerebellum is unaffected (Marie's title incorrect).

SUBACUTE COMBINED DEGENERATION OF THE SPINAL CORD.

A disease associated with pernicious anæmia, characterized by sensory and motor symptoms due to combined degeneration of the posterior and lateral columns of the cord.

Morbid Anatomy.—

SPINAL CORD.—Normal in size or swollen by œdema. Degenerated areas in: (1) Posterior columns; (2) Lateral columns, including pyramidal and cerebellar tracts. Areas of demyelination begin in centre of white columns, long fibres first affected; areas commence at any site, extend and coalesce until whole white matter of cross-section may be affected. Earliest change: swelling of medullary sheath, then fatty degeneration; later, axis-cylinder degenerates. Finally, in advanced cases, only connective tissue with fluid in spaces. Thoracic region most affected. Gray matter normal.

PERIPHERAL NERVES—Slight changes only

Pathogenesis.—Cause is closely related to, but probably not identical with, that of pernicious anæmia. Note:—

1. Nervous lesions may precede anæmia: latter rarely absent.
2. Anæmia may precede nervous lesions. Efficient substitution therapy for pernicious anæmia is preventive.

Symptoms.—Combination of: (1) *Anæmia*: pallor, dyspnœa, palpitations, swelling of legs, etc. (2) *Sensory and motor symptoms*, commencing in legs, due to postero-lateral sclerosis: (a) *Numbness and tingling*; (b) *Sensory changes*—anæsthesia, pain; (c) *Paraplegia*—usually spastic in early and flaccid in late stage. Finally: (d) *Wasting*; (e) *Sphincters affected*. *Pyrexia* slight.

THREE STAGES of the nervous symptoms have been described, but variations are common.

1. **FIRST STAGE.**—*Slight spastic or ataxic paraplegia*. Onset insidious: numbness and tingling in legs. Then symptoms of 'spastic ataxia': weakness, inco-ordination, spasticity, and increased reflexes—viz., knee-jerks increased, ankle-clonus present, and extensor plantar reflex. Duration: several months.
2. **SECOND STAGE.**—*Marked spastic paraplegia* develops rapidly.
 - a. *Rapid paralysis*: unable to stand. Rigidity marked.
 - b. *Anæsthesia*: commences in legs, often of 'stocking' distribution, ascends rapidly, loss of pain preceding touch; in trunk, upper limit well defined. Girdle pains and lightning pains in legs may occur.
 - c. *Reflexes increased*.
3. **THIRD STAGE.**—*Flaccid paraplegia* supersedes the spasticity.
 - a. *Flaccid paralysis*. Rapid wasting.
 - b. *Deep reflexes absent*, but Babinski's sign usually persists.
 - c. *Sphincters*: loss of control.
 - d. *Anæsthesia* increases.

Upper extremities may be affected. Œdema usual. Mental symptoms frequent terminally.

GASTRIC JUICE.—Free HCl absent.

Subacute Combined Degeneration of the Spinal Cord, *continued*.

Diagnosis.—Characterized by combination of *severe anæmia* with sensory and motor changes. Difficult in early stages. Diagnosis from :—

DISSEMINATED SCLEROSIS.—Distinguished therefrom by : later age, anæmia, anæsthesia, pains, absence of nystagmus.

TABES.—Distinguished therefrom (even in flaccid condition) by : anæmia, anæsthesia, absence of pupil changes, extensor plantar response.

PERIPHERAL MULTIPLE NEURITIS.—Distinguished therefrom by : anæmia, affection of sphincters, extensor plantar response.

TUMOURS INVOLVING CORD.—In these : initial root pains, symptoms asymmetrical.

ACUTE MYELITIS has a more rapid onset.

PELLAGRA.—Nervous symptoms and histological changes somewhat similar.

Course and Treatment—

WITHOUT LIVER TREATMENT.—*Progressive*. Duration : few months up to two to six years. Final stages rapid. Emaciation and weakness extreme, and death from exhaustion, cystitis, bed-sores, and cardiac or respiratory failure.

WITH LIVER TREATMENT.—Red cells and hæmoglobin must be maintained at full normal. Very large doses of liver extract must be continued with injections. Nervous symptoms do not advance : some improvement occurs due to treatment of anæmia and re-education. Recovery under treatment of functions lost organically is in dispute. Vitamin B to be given freely.

CHAPTER CLXVII.

MUSCULAR DISEASES.

I. MYELOPATHIC MUSCULAR ATROPHY.

A group of diseases in which *progressive* atrophy of the muscles results from a primary degeneration of the cells of the anterior horns or of the corresponding motor nuclei of the cranial nerves. Hence the lesion is essentially of the lower motor neurons ; in some forms the upper motor neurons are also affected. Intermediate forms occur between the various groups.

Types.—The following types are generally recognized :—

1. **PROGRESSIVE MUSCULAR ATROPHY.**—Sometimes referred to as 'type Aran-Duchenne' or 'Duchenne-Aran'. Degeneration in the cells of the anterior horns (lower motor neuron). Commonest type.
2. **AMYOTROPHIC LATERAL SCLEROSIS.**—Degeneration in cells of anterior horns and in pyramidal tracts (lower and upper motor neurons).

3. PROGRESSIVE BULBAR PARALYSIS or GLOSSO-LABIO-LARYNGEAL PARALYSIS.—Degeneration in certain motor cranial nuclei in the medulla. Rare.

4. PROGRESSIVE OPHTHALMOPLEGIA.—Degeneration in oculomotor nuclei. Very rare.

Rare type:—

5. PROGRESSIVE MUSCULAR ATROPHY OF CHILDHOOD (Werdnig-Hoffmann type.)

1. PROGRESSIVE MUSCULAR ATROPHY.

(*Chronic Anterior Poliomyelitis.*)

A chronic progressive disease of the spinal cord, characterized pathologically by degeneration of anterior horn cells, and clinically by wasting and weakness of the related muscles.

Etiology.—

AGE.—Adults, 25 to 40 years.

SEX.—Commoner in males.

PREDISPOSING FACTORS.—Rarely recognizable; is a *primary degeneration*. Very rarely commences in injured limbs (? hæmorrhages into cord); or infantile paralysis previously present (Potts). Syphilis, no connection. No hereditary or familial factors (see WERNIG-HOFFMANN TYPE, p. 964).

Pathology.—Commences usually in *lower portion of cervical enlargement*—viz., first dorsal segments.

1. ATROPHY AND DEGENERATION OF CELLS OF ANTERIOR HORNS.—May extend into anterior roots and portions of peripheral nerves. As secondary changes, proliferation of neuroglia, and occasionally small hæmorrhages.

2. ATROPHY OF MUSCLES.—Distribution irregular, normal fibres remaining.

Pyramidal tracts appear normal macroscopically; slight changes may be demonstrated by methods of Marchi and Nissl. Rarely changes in other tracts, e.g., spino-cerebellar.

Symptoms.—Characterized by *wasting and weakness of muscles*.

ONSET insidious, usually in small muscles of one hand, commonly right; other hand affected after interval often of months. Progress bilateral, but more advanced on one side.

1. EARLIEST STAGE.—(a) *Thumb muscles* of abduction and apposition affected; (b) Then other *small muscles of hand*, viz., little finger, interossei, lumbricales.

CONDITION OF HAND: (a) Wasting of thenar, hypothenar, and interossei muscles; (b) Finer movements difficult.

POSITION OF HAND ON DEVELOPMENT: (a) 'Main-en-griffe' or 'claw-hand', from unopposed action of long flexors and extensors; (b) Thumb rotated outwards, becoming flat with palm (ape-hand).

Note.—Claw-hand absent if forearm affected early.

2. PROGRESS.—

ORDER OF AFFECTION.—(a) *Forearm*. Flexors before extensors. Of flexors, fingers before wrists; of extensors, wrists before

Progressive Muscular Atrophy—Symptoms, continued.

fingers. (b) *Upper arm and shoulder.* *Deltoid* early affected, then *biceps*. (c) *Serratus magnus*, whence 'winged scapula'. Also *rhomboids* and lower *trapezius*.

MUSCLES ESCAPING.—(a) *Trapezius*, upper portion (even in late stages). (b) *Pectoralis major*, lower half. (c) *Triceps*. (d) *Latissimus dorsi*.

3. **ADVANCED STAGES.**—*Neck muscles*: head hangs forward. *Intercostals and abdominal muscles*: respiration diaphragmatic. *Legs*: affected late. *Face* often escapes.

GENERAL CHARACTERISTICS.—(See LOWER MOTOR NEURON LESIONS, p. 917.)

1. **WASTING.**—Finally becomes extreme and universal, both muscle and fat.
2. **FIBRILLARY TREMORS** common; marked on striking muscles; occur in muscles previous to obvious changes.
3. **DEEP REFLEXES** diminished or lost, from atrophy of muscles and breaking of reflex arc.
4. **ELECTRICAL CHANGES.**—'Partial reaction of degeneration': distinguishes myelopathic from myopathic muscular atrophies.
 - a. *Nerves.*—Response normal in type, but diminished.
 - b. *Muscles.*—(i) To faradic current: react (through nerves). (ii) To galvanic current: (a) sluggish response; (β) A.C. contraction greater than K.C. contraction. Reactions vary in different parts of same muscle. Finally, all response lost.
5. **SENSATION** normal. Occasional aching as in over-fatigue.
6. **SPHINCTERS** unaffected.

Clinical Variations.—Rare. (1) *Shoulder* affected first; commences in *deltoid*; lesion in upper portion of cervical enlargement. (Lead is a possible factor.) (2) *Forearm* first; *no main-en-griffe*. (3) *Legs* first; very rare; commences in *peronei*. All intermediate forms occur between progressive muscular atrophy and amyotrophic lateral sclerosis.

Diagnosis.—Mainly from conditions causing *wasting of hands*; in most of these pain and sensory changes occur.

1. **PERIPHERAL NEURITIS AND PERIPHERAL NERVE LESIONS.**—Pain, sensory changes, distribution of wasting, causal factors. In lead, small muscles rarely affected.
2. **SYRINGOMYELIA.**—Sensory changes.
3. **CERVICAL RIB.**—Unilateral. Sensory symptoms. X rays.
4. **CERVICAL CORD LESIONS: TUMOURS, SYPHILIS, CARIOS, PACHYMENINGITIS.**—Pain and sensory changes.
5. **MYOPATHIES.**—Resemblance mainly in 'shoulder' type. Note: (a) Onset at earlier age; (b) Enlargement of certain muscles; (c) No fibrillary tremors; (d) No reaction of degeneration; (e) Affection of muscles escaping in progressive muscular atrophy. (See also MUSCULAR DYSTROPHIES, p. 964.)

6. **AMYOTROPHIC LATERAL SCLEROSIS.**—(a) *Progress* more rapid; (b) Often affects muscles in groups; (c) *Deep reflexes* increased markedly; (d) *Spasticity of legs*; (e) *Bulbar paralysis* common.

Course.—Slowly progressive. *Death* in five to fifteen or twenty years; usually from diseases or failure of respiration. Development of bulbar paralysis is rare.

Treatment.—General hygiene and tonics. Strychnine. Massage. Electricity.

2. AMYOTROPHIC LATERAL SCLEROSIS.

A chronic progressive disease of the spinal cord, characterized pathologically by degeneration of the pyramidal tracts and of the cells of the anterior horns, and clinically by a combination of atrophy and spasticity in the related muscles.

Etiology.—Commoner in females. Otherwise as in progressive muscular atrophy, but is considerably rarer.

Pathology.—Degeneration of both lower and upper motor neurons.

1. **CELLS OF ANTERIOR HORNS.**—As in progressive muscular atrophy. *Motor nuclei in medulla* (and rarely pons) may also atrophy.

2. **PYRAMIDAL TRACTS.**—The degeneration extends upwards, and is traced, by methods of Marchi and Nissl, through medulla and pons to cortex.

May commence in either of the two sites, or simultaneously in both; commonly in cervical enlargement; occasionally in bulbar nuclei.

Pathologically and clinically, the condition is a combination of progressive muscular atrophy and lateral sclerosis.

Symptoms.—

ONSET insidious. Either: (1) *Wasting and weakness in upper limbs*, as in progressive muscular atrophy; or (2) *Spasticity in lower limbs*; or a combination.

UPPER LIMBS.—*Wasting and weakness*. Order of affection closely as in progressive muscular atrophy—small muscles of hands, forearm, upper arm, and shoulder—but tends to affect groups of muscles, e.g., entire forearm, simultaneously. Similar deformities of hand (claw-hand, ape-hand). Contractures commence.

LOWER LIMBS.—*Spasticity and weakness without wasting* (upper motor neuron type). *Gait* becomes spastic.

ADVANCED STAGES.—

1. **UPPER LIMBS.**—(a) Atrophy. (b) Contractures: flexion of fingers, wrists, and elbow, but generally not extreme.
2. **LOWER LIMBS.**—Varying degrees of spasticity, flaccidity, and atrophy, but last not to same extent as arms.
3. **BULBAR PARALYSIS** frequently develops. Speech, tongue, lips, palate, and pharynx affected.

Amyotrophic Lateral Sclerosis—Symptoms, continued.

GENERAL CHARACTERISTICS.—

1. **WASTING AND ATROPHY**, with some spasticity, of upper limbs; **SPASTICITY**, with some atrophy, of lower limbs. **BULBAR PARALYSIS** frequent later.
2. **FIBRILLARY TREMORS**.
3. **DEEP REFLEXES** greatly and universally increased. Practically sole condition in which *jaw-clonus* occurs. *Ankle-clonus* present. Usually Babinski's sign (not invariably).
4. **ELECTRICAL REACTIONS**.—Excitability diminished. May be 'partial reaction of degeneration' (see **PROGRESSIVE MUSCULAR ATROPHY**, p. 960). Finally no response.
5. **SENSATION** normal.
6. **SPHINCTERS** unaffected.

Types.—May commence as bulbar paralysis. Other types of onset, and intermediate forms, as in progressive muscular atrophy.

Diagnosis.—*Lead poisoning* may, very rarely, produce symptoms resembling the type commencing in the forearms. For diagnosis from other conditions, see **PROGRESSIVE MUSCULAR ATROPHY**.

Course.—Usually fatal in two to four years: especially from development of *bulbar paralysis*.

Special Treatment.—Hot baths, massage, and passive movements to prevent contractures.

3. PROGRESSIVE BULBAR PARALYSIS.

(*Glosso-Labio-Laryngeal Paralysis*.)

A rare disease characterized pathologically by degeneration of motor nuclei of medulla and occasionally of pons, and clinically by atrophy and loss of function in the related muscles.

Not uncommonly occurs in late stages of amyotrophic lateral sclerosis, rarely in progressive muscular atrophy.

Etiology.—As in **PROGRESSIVE MUSCULAR ATROPHY**.

Pathology.—Primary degeneration of cells in motor nuclei of bulb: most advanced in 11th and 12th nuclei, less so in the nucleus ambiguus (the common motor nucleus of the vago-glossopharyngeal nerve); occasionally in motor nuclei of 5th and 7th.

Pyramidal tracts probably always affected to some degree.

Symptoms.—

ONSET and PROGRESS.—Gradual. *Tongue, lips, pharynx, and larynx* most affected.

SPEECH affected first, becomes indistinct. Earliest, consonants l, r, n, s, t (linguals); then o, u, p, b, m.

TONGUE.—(1) Weakness in moving and protruding it; (2) Wasting marked; (3) Wrinkling of mucous membrane; (4) Fibrillary contractions.

LIPS become weak (*orbicularis oris*), with some wasting. Whistling, blowing, etc., impossible.

PARALYSIS OF PALATE.—Voice nasal. Regurgitation of fluids. **SWALLOWING AND MASTICATION** affected by: (1) Weakness of tongue; (2) Paralysis of palate; (3) Paralysis of pharyngeal muscles. Also by loss of reflex from larynx (food enters glottis). **VOICE** affected by: (1) Paralysis of palate (nasal tone); (2) Paralysis of adductors of vocal cords (voice feeble, coughing ineffectual); also (3) Paralysis of tongue and lips. **MASSETERS, PTERYGOIDS, and TEMPORAL MUSCLES** may be affected.

ELECTRICAL REACTIONS.—As in **PROGRESSIVE MUSCULAR ATROPHY**, p. 960.

REFLEX from soft palate absent; may be also from larynx (arc interrupted).

SENSATION normal.

KNEE-JERKS may be increased (pyramidal tracts affected).

ADVANCED STAGE.—Characteristic. (1) *Mouth* open; saliva dribbling. (2) *Lower lip* pendulous. (3) *Muscles above mouth* unaffected. (4) *Tongue*: atrophy marked, motionless. (5) *Speech*, unintelligible. (6) *Swallowing* difficult.

Course.—Progressive and fatal: duration about 2 years. *Death* from: (1) Aspiration pneumonia—occasionally suffocation; (2) Exhaustion from difficulty in feeding; (3) Occasionally, cardiac and respiratory disturbances (vagus nerve).

Treatment.—Careful feeding, nasal when necessary.

Bulbar Paralysis: General Causes and Diagnosis.—Paralysis of the cranial nerves with motor nuclei in the bulb may result from the following lesions:—

1. **SUPRANUCLEAR**—i.e., 'pseudo-bulbar paralysis'.

2. **NUCLEAR AND INFRANUCLEAR.**—

a. '*Acute bulbar paralysis*': (i) Vascular lesions; (ii) Post-diphtheritic paralysis, and very rarely in other post-febrile conditions; (iii) Rarely in acute poliomyelitis.

b. *Chronic*: (i) *Progressive bulbar paralysis*; (ii) *Tumours* in medulla—very rare; (iii) Conditions at the base of the brain—i.e., extramedullary.

3. **MYASTHENIA GRAVIS.**

Wassermann reaction should always be tested.

PSEUDO-BULBAR PARALYSIS.—Not uncommon. Diagnosis difficult. Due to bilateral lesions (e.g., hæmorrhage) of tracts between motor cortex and bulbar nuclei, most commonly in internal capsule. Note: (1) Two sides not affected simultaneously (except rarely with lesion just above nuclei), viz., history of two attacks of hemiplegia, with bulbar symptoms following the second; (2) Paralysis of *upper motor neuron type*—i.e., no wasting, no electrical changes, reflexes present.

VASCULAR LESIONS IN MEDULLA (hæmorrhage, thrombosis—may be syphilitic).—Sudden onset; less symmetrical; may improve subsequently.

POST-DIPHTHERITIC PARALYSIS.—Onset rapid; history of diphtheria or sore throat; other nerves affected; short duration, and recovery. Very rarely is permanent, but never progressive.

Bulbar Paralysis—General Causes and Diagnosis, *continued*.

CONDITIONS AT BASE OF BRAIN (meningitis—especially syphilitic—tumours, etc.).—Not uncommon, but *lesions unilateral*. Usually other symptoms. Unilateral bulbar paralysis suggests syphilis.

MYASTHENIA GRAVIS.—Note: (1) Tendency to remissions; (2) 'Myasthenic reaction'; (3) No wasting, no reaction of degeneration. No lesions in nervous system. (See p. 969.)

4. PROGRESSIVE OPHTHALMOPLEGIA.

Very rare. A progressive degeneration of the oculomotor nuclei, corresponding to progressive bulbar paralysis; usually produces ophthalmoplegia externa; very rarely total ophthalmoplegia results, externa and interna. Bulbar paralysis may also develop. (See OPHTHALMOPLEGIA, p. 995.)

5. PROGRESSIVE MUSCULAR ATROPHY OF CHILDHOOD.

(*Werdnig-Hoffmann Disease*.)

A rare disease characterized by *symptoms* resembling progressive muscular atrophy commencing in infancy, with *pathological changes* resembling amyotrophic lateral sclerosis.

Morbid Anatomy.—Degeneration of anterior horns and pyramidal tracts. Extensive distribution, also in bulbar nuclei. Muscles atrophied.

General Characteristics.—

1. **FAMILIAL** disease. Transmitted by either sex.
 2. **ONSET** in infancy: 6 to 9 months. **PROGRESS** slow.
 3. **PARESIS AND ATROPHY** of muscles: symmetrical: *proximal segments of limbs*. Earliest in thigh, trunk, and pelvis; later, upper limbs and neck. Child unable to walk or stand. Contractures develop.
 4. **REFLEXES** absent. Muscles flaccid. May be fibrillary tremors.
 5. **ELECTRICAL REACTIONS** diminished, or reaction of degeneration.
 6. **SENSATION** normal.
- Life rarely exceeds a few years.

II. MYOPATHIC MUSCULAR ATROPHY: THE MUSCULAR DYSTROPHIES.

A group of diseases in which muscular weakness and atrophy result from primary changes in the muscles. In some forms an initial increase in size occurs in certain muscles.

Etiology.—

No predisposing factors known except *hereditary and familial*.

Onset in childhood, shortly after birth, or up to puberty; rarely later.

Pathogenesis.—Believed that muscles are unable to fix creatine.

Morbid Anatomy.—Muscle fibres atrophied; nuclei increased in number. When 'hypertrophy' present: (1) Muscle fibres increased in size but probably not in number; (2) Excess of fat; (3) Increase of connective tissue. The enlargement is mainly (but not entirely) a 'pseudohypertrophy' not due to muscle fibres; the enlarged muscles atrophy later.

Nervous system normal: or slight secondary changes in anterior horns.

Types.—Partly differentiated by presence or absence of 'hypertrophy' of muscles, but some initial enlargement may be present in any type, and intermediate forms occur.

TYPES GENERALLY RECOGNIZED.—

1. PSEUDOHYPERTROPHIC MUSCULAR PARALYSIS.
2. ERB'S JUVENILE TYPE.
3. FACIO-SCAPULO-HUMERAL TYPE (Landouzy-Dejerine type).

RARE AND ATYPICAL FORM.—

4. 'DISTAL' TYPE (Gowers and Spiller).—Affects fingers, wrists, toes, and ankles; occasionally face
Onset: infancy or later. *Diagnosis* from progressive neural muscular atrophy by absence of sensory changes and affection of face.

INTERMEDIATE DISEASES.—

5. PROGRESSIVE NEURAL MUSCULAR ATROPHY.—Allied to both myopathic and myelopathic atrophy.
6. AMYOTONIA CONGENITA.
7. MYOTONIA ATROPHICA.

Diagnosis.—Distinction of *muscular dystrophies* (myopathies) from *myelopathic muscular atrophies*:—

1. ONSET at earlier age.
2. FAMILY AND HEREDITARY FACTORS marked: absent in myelopathies.
3. DISTRIBUTION OF CHANGES.—(a) Affects mainly the *larger* muscles and *proximal* segments of limbs. (b) Forearm and hands escape, and deltoid often does so. (c) In some forms, enlargement of certain muscles, viz., calf, infraspinatus, etc. (d) Muscles escaping in myelopathic atrophies are affected—viz., trapezius, pectoralis major, latissimus dorsi, triceps. (e) No bulbar paralysis, larynx never affected.
4. REFLEXES never increased: diminish in relation to wasting.
5. FIBRILLARY TREMORS absent, or occur rarely.
6. ELECTRICAL REACTIONS diminish in general with wasting, but no 'reaction of degeneration'.

Difficulty greatest in rare 'shoulder type' of progressive muscular atrophy.

Diagnosis also from: (1) *Cerebral lesions*: paralysis long precedes atrophy. (2) *Multiple neuritis*: rapid onset, distribution of paralysis, and sensory changes. (3) *Progressive neural muscular atrophy*.

PSEUDOHYPERTROPHIC MUSCULAR PARALYSIS.

A chronic disease characterized clinically by progressive weakness and atrophy of muscles, with an initial increase in size of certain muscles, and pathologically by absence of primary changes in the nervous system.

Etiology.—

AGE OF ONSET.—Usually early childhood, 4 to 10 years; occasionally as late as puberty; rarely subsequently.

SEX.—Males predominate, boys 4 or 5 to girls 1.

HEREDITY.—Often familial, the girls usually escaping. Tends to be exhibited by males and transmitted by females.

Symptoms.—

INITIAL SYMPTOMS.—Clumsiness and frequent falls in walking or standing.

MUSCLE CHANGES.—

1. **DISTRIBUTION OF HYPERTROPHY OF MUSCLES.**—Most constant: (a) *Calf* (gastrocnemius and soleus); (b) *Infra-spinatus*. Frequently: (c) Quadriceps extensor; (d) Glutei; (e) Triceps. Occasionally: Deltoid, supraspinatus. Very rarely: Masseters, tongue.

2. **ATROPHY OF MUSCLES.**—Most constant: (a) *Latissimus dorsi*; (b) *Pectoralis major, lower portion*. Frequently: (c) Flexors of knee; (d) Peronei; (e) Erector spinæ and trunk muscles; (f) Biceps; (g) Teres major.

3. **MUSCLES ESCAPING.**—(a) Face; (b) Forearm and hand—rarely supinator longus wastes.

CHARACTERISTIC PHENOMENA.—

1. **ATTITUDE.**—Stands with feet apart and shoulders thrown back. Marked *lordosis* and *protuberant abdomen*.

2. **GAIT** waddling: feet wide apart, often lifted high ('steppage').

3. **RISING FROM GROUND WHEN SUPINE** (Gowers' pathognomonic figures).—Rolls over on to hands and knees; extends knees with feet apart; moves hands along floor towards span of feet, and then climbs up the legs, with a final jerk to the upright position. (Due to weakness of extensors of knees and hips.)

4. **'SLIPS THROUGH THE HANDS'** when attempt is made to lift child with hands in axilla. (From absence of axillary folds through atrophy.)

ELECTRICAL REACTIONS diminish quantitatively until finally absent, from atrophy of muscular fibres. *No reaction of degeneration.*

SENSATION unchanged.

SPHINCTERS unaffected.

Course.—Slow progressive atrophy and weakness of muscles, including hypertrophied muscles in later stages; finally helpless.

DEFORMITIES may develop: (1) *Lateral curvature of spine*—common; (2) *Talipes equinus* occasionally, from contraction of gastrocnemius.

GENERAL HEALTH fair until terminal stages.

DEATH: *usually about puberty*, from exhaustion, or from pulmonary or intercurrent disease.

Treatment.—Unsatisfactory. General hygiene and tonics. *Treatment of muscles*: massage, electricity, active and passive movements. *Exercise* beneficial. Keep from becoming bedridden as long as possible.

Glycin (glycocol, amino-acetic acid): $\bar{3}$ ss b.d., by mouth. Improvement claimed. Affects creatine metabolism.

ERB'S JUVENILE TYPE.

Etiology.—

SEX.—Boys and girls equally affected (compare previous type).

AGE AT ONSET.—Commonly second decade, in the 'teens'.

HEREDITARY factor common.

Symptoms.—

MUSCLE CHANGES.—

HYPERTROPHY is never marked: may be slight grades.

ORDER OF AFFECTION.—(1) Upper extremity: biceps, triceps, supinator longus, and deltoid (especially upper portion).

(2) Trunk: latissimus dorsi, pectoralis major (mainly lower portion), trapezius, serratus magnus and rhomboids, erector spinæ. (3) Thigh and pelvis: glutei, flexors and extensors of knee, occasionally tibialis anticus.

ATROPHY AND WASTING.—Commences in large muscles about shoulder and upper arm; then trunk, thigh, and pelvis.

MUSCLES ESCAPING.—(1) *Forearm* (except occasionally supinator longus); (2) *Leg below knee*. These contrast with atrophy in proximal segments. (3) *Face*. (4) *Infraspinatus* and *supraspinatus*, commonly.

CHARACTERISTIC PHENOMENA.—*Lordosis* common (disappears on sitting). *Attitude, gait, and method of rising from the ground* often as in pseudohypertrophic type.

Course.—*Progressive atrophy and weakness*, but occasionally stationary for some years; duration of life longer than in previous type.

FACIO-SCAPULO-HUMERAL TYPE.

(Type Landouzy-Dejerine.)

Onset in *infancy*, with weakness and wasting of *muscles of face*. Progress and symptoms otherwise resemble Erb's juvenile type—probably identical. *Hereditary* factor common.

Symptoms.—(1) *Face muscles* affected: especially orbiculares oris and palpebrarum. Characteristics: (a) Eyes cannot be closed; (b) Blowing and whistling impossible; (c) Lips are everted; (d) Smiles with straight lips, 'rire en travers'. Later involvement of large muscles of: (2) Shoulders and upper arm; (3) Trunk; (4) Thigh and pelvis (*see* ERB'S TYPE). Hypertrophy of muscles never marked: may be slight grades.

PROGRESSIVE NEURAL MUSCULAR ATROPHY.*(Peroneal Muscular Atrophy. Charcot-Marie-Tooth Type.)*

A chronic disease commencing in early life, characterized clinically by slow muscular atrophy of distal segments of limbs, and pathologically by changes in the nervous system.

A very rare disease, allied to both myopathic and myelopathic atrophies, and possibly to multiple neuritis.

Etiology.—

AGE.—Onset usually in first decade.

SEX.—Both sexes, but boys 4 or 5 to girls 1.

HEREDITARY AND FAMILIAL FACTORS marked. Transmitted apparently through females (Herringtonham).

Morbid Anatomy.—Degeneration of anterior horn cells of affected regions, with atrophy of peripheral nerves. Also of cells of Clarke's column and posterior and postero-lateral columns. Atrophy of muscle columns.

Symptoms.—

MUSCLE CHANGES.—*Atrophy of muscles*, in order: (1) *Peronei and small muscles of feet*; whence *talipes equinus* or *equinovarus* develops. (2) Extends up lower extremity until *all muscles wasted below knee*, while thigh little affected ('inverted bottle-shaped leg'). (3) Upper limb affected after interval of several years; commences in *small muscles of hand*; 'claw-hand' develops. Often no further progress: rarely trunk and thigh muscles affected later.

SENSORY CHANGES may occur: pains in legs, areas of anæsthesia. Muscles not tender.

FIBRILLARY TREMORS present.

REFLEXES.—Ankle-jerk absent. Knee-jerks present.

ELECTRICAL REACTION.—Varies from quantitative diminution of response to complete reaction of degeneration.

SPHINCTERS unaffected.

Course.—Very chronic. Often becomes arrested. Life not necessarily shortened.

General Characteristics.—*Bilateral acquired club-foot*; *slow symmetrical atrophy of distal segments*, commencing in *early life*. Resembles: (1) Myopathies in early onset and familial factors; (2) Myelopathies in distal distribution, electrical changes, fibrillary tremors, and occurrence of changes in the nervous system. Differs from both in sensory changes. Differs from *acute poliomyelitis* by slow progress.

AMYOTONIA CONGENITA.*(Myatonia. Oppenheim's Disease.)**

A congenital affection characterized by general flaccidity of the muscles and absence of deep reflexes. Usually noticed at birth or shortly after. Rarely familial. Probably a primary disease of muscles: classified with muscular dystrophies by some authorities as 'simple atrophic dystrophy'.

* Oppenheim first described the condition and called it myatonia, a name now generally abandoned owing to its similarity to myotonia (Thomsen's disease.)

Symptoms.—(1) *Flaccidity of muscles* extreme. Muscles small, but not atrophied. *Joints* are abnormally movable. (2) *Weakness* extreme, but no paralysis, voluntary control of muscles being present. (3) *Deep reflexes* absent. (4) *Faradic excitability* diminished.

Limbs, especially lower, most affected; face escapes, except rarely. No mental, sphincter, or sensory changes, or lesions of nervous system.

Child often unable to walk, but rolls or scrambles over floor. Collapses forward if sitting (Batten's 'frog child').

Course.—Tendency to improvement, but death from pulmonary affections common, respiratory muscles being affected.

MYOTONIA ATROPHICA.

(*Dystrophia Myotomca.*)

A rare familial condition characterized by myotonia, by muscular dystrophy of special distribution, and by certain extra-muscular dystrophic symptoms.

Note.—Has resemblances to myotonia congenita: suggests error of metabolism.

Morbid Anatomy.—Atrophy of affected muscle fibres with some giant fibres. No changes in nervous system or endocrines.

Characteristics.—

1. **FAMILIAL DISEASE.**—Heredity slight.
2. **ONSET.**—Age, 20 to 30 years. *Progress* slow. Life not shortened.
3. **MYOTONIA.**—Slow relaxation after muscular contraction. Exhibited well by hand grip, smile, and difficulty in closing eyelids. Erb's 'myotonic reaction' partly present.
4. **MUSCULAR ATROPHY.**—Especially affects *sternomastoids*, face, hands and forearms, anterior thigh muscles. No fibrillary contractions. No reaction of degeneration.
5. **EXTRA-MUSCULAR DYSTROPHIC SYMPTOMS.**—Cataract, baldness, emaciation, impotence.

III. CERTAIN OBSCURE DISEASES.

1. MYASTHENIA GRAVIS.

(*Asthenic Bulbar Paralysis. Erb-Goldflam's Disease.*)

An affection characterized by rapid exhaustion of the voluntary muscles on repetition of movement or stimulation by the faradic current, with recovery on rest. Muscles innervated by the bulb and cranial nerves are specially, but not exclusively, affected.

Lesion is of *muscular and not of nervous origin.*

Etiology.—

AGE.—20 to 40 years.

SEX.—Rare in males.

Myasthenia Gravis—Etiology, *continued*.

HEREDITARY OR NEUROPATHIC FACTOR.—None. Association in several cases with Graves' disease, and in some with congenital malformations, e.g., polydactyly.

Predisposing causes unknown. Has followed infective fevers. May improve during pregnancy, but not invariably.

Morbid Anatomy.—Nervous system normal. Main lesions are:—

1. Small round-cell infiltrations and serous exudations between muscle fibres and in tissues (Farquhar Buzzard's 'lymphorrhages'): insufficient to affect muscle mechanically.
2. Thymus: proliferation and persistence frequent, but not constant. Graves' disease may coexist.

Pathogenesis.—Defect exists at motor end-organs. Note: (1) Resemblance of abnormal muscle fatigability in myasthenia gravis to curare poisoning suggests myoneural junction as seat of lesion; (2) Normal transmission of impulses from motor nerve-endings to voluntary muscles depends on liberation in endings of acetylcholine (Dale); (3) In myasthenia, there is premature destruction or failure in liberation of acetylcholine; (4) Prostigmine temporarily delays destruction of acetylcholine by enzyme in the blood and during such time muscular contraction is normal.

Symptoms.—

MYASTHENIC PHENOMENON.—A movement is performed normally, but on repetition rapidly weakens and becomes impossible; power recovered after rest. More marked towards end of day. Distribution bilateral, but not strictly symmetrical.

MYASTHENIC REACTION.—(1) Strong faradic current: normal contraction, becoming feebler and then ceasing. (2) Galvanic current: reactions unchanged.

DISTRIBUTION OF AFFECTION OF MUSCLES in order of frequency and severity: (1) Muscles supplied by cranial nerves, especially ocular; (2) Neck; (3) Respiration; (4) Limbs and trunk.

PROMINENT SYMPTOMS.—

1. **OCULAR AFFECTIONS.**—(a) *Bilateral ptosis*: rarely absent. (b) *Orbicularis palpebrarum*: slight resistance prevents closure: rarely unaffected. (c) *Strabismus* and diplopia: finally complete ophthalmoplegia externa. Pupil never affected. Coarse nystagmoid movements common.

2. **FACIAL MUSCLES, ETC.**—(a) *Power of expression* lost: face immobile: whistling, etc., impossible. (b) *Jaw muscles*: *Mouth open*: saliva drips. *Mastication* difficult. (c) *Palate*: nasal speech: regurgitation of fluids. Articulation impaired.

3. **NECK MUSCLES.**—Inability to hold up head.

4. **RESPIRATORY MUSCLES.**—Attacks of dyspnoea severe: may be fatal.

Later than above:—

LIMBS affected: usually proximal muscles.

TRUNK muscles affected.

Symptoms exhibited markedly by: (1) Looking up and down repeatedly: ptosis. (2) Reading aloud: tires rapidly: nasal speech. (3) Tongue put in and out. (4) Watch palate while patient says 'Ah' repeatedly: movement diminishes rapidly.

SENSATION unchanged. Aching, rarely severe pain.

ATROPHY OF MUSCLES occasionally in face.

Mental condition normal. Sphincters unaffected. Knee-jerks weaker on repetition.

Diagnosis and General Characteristics.—In advanced cases usually simple: (1) Bilateral ptosis; (2) Facial expression; (3) Nasal speech and open mouth; (4) Rapid exhaustion; (5) No atrophy or sensory changes; (6) Myasthenic reaction (but occasionally absent, and also rarely present in *neurasthenia*); (7) Remissions.

IN HYSTERIA.—Sensation altered; no myasthenic reaction.

IN BULBAR PARALYSIS.—Ocular muscles unaffected; no remissions.

Course and Prognosis.—Remissions and fluctuations marked. Usually fatal in two or more years, from respiratory failure and septic pneumonia. May be many years.

Treatment.—

PROSTIGMINE (Roche).—A synthetic derivative of physostigmine. Hypodermic injection of 0.5 per cent solution, 2 to 4 c.c. (atropine sulphate gr. $\frac{1}{100}$ may be added): results in immediate restoration of power, lasts 4 to 5 hours. Toxic effects: depression, abdominal pain, frequency of micturition. Not suitable for routine use, but for emergencies. Oral effect slight.

EPHEDRINE SULPHATE.—Gr. $\frac{1}{2}$, t.d.s., with glycine $\bar{5}$ ss b.d., causes some improvement.

2. MYOTONIA CONGENITA.

(*Thomsen's Disease.*)

A very rare affection characterized by a peculiar 'stiffness' on attempting voluntary movements.

Etiology.—

HEREDITARY and FAMILIAL disease.

SEX.—Males much commoner than females.

Onset noted in childhood from inability to play games.

Morbid Anatomy.—

NERVOUS SYSTEM.—No changes (one autopsy recorded).

MUSCLES.—Fibres greatly increased in width; transverse striation feeble; nuclei of sarcolemma numerous. No increase of connective tissue.

Pathogenesis.—Unknown. Undoubtedly a pathological condition of muscular tissue, possibly an error of metabolism. In animals, similar contractions follow veratria or sodium phosphate in large

Myotonia Congenita—Pathogenesis, *continued*.

doses, even after injection of curare (Ringer and Sainsbury). Uncertain whether thickening of muscle fibres is primary or secondary: if latter, is secondary to original cause and not to peculiarity of contraction.

Symptoms.—On commencing a voluntary movement, the muscles involved having been at rest, the contraction is very slow; and, having contracted, *relaxation is equally slow*. On repetition, 'stiffness' passes off gradually, and movement is finally performed at normal rate. Well illustrated by 'shaking hands', gripping being slow, and, after closure, interval of seven to ten seconds before opening can occur; also by attempting to walk after resting.

MUSCLES AFFECTED.—Legs, arms, and trunk. Frequently, mastication and face. Eyes rarely.

MUSCLES UNAFFECTED.—Involuntary muscles. Respiration, deglutition, micturition, defæcation.

SENSATION and REFLEXES normal.

ERB'S ELECTRICAL REACTION ('*myotonic reaction*').—(1) Both to faradic and constant current, contraction attains maximum slowly and relaxes slowly: on repetition, gradually becomes normal. (2) A.C.C. almost equal to K.C.C.

UNAFFECTED by emotion or cold. **INCREASED** by fatigue.

CONDITION OF MUSCLES.—Normal or hypertrophied, but force of contraction subnormal.

Direct percussion of muscle causes slow contraction.

Treatment.—None effective. The disease does not shorten life.

Atypical Varieties.—

PARAMYOTONIA CONGENITA.—Condition present in cold weather only. Eyes usually affected. Non-hereditary and other varieties recorded in rare instances.

MYOTONIA ATROPHICA.—Type intermediate between Thomsen's disease and muscular dystrophy (*see* p. 965).

3. PARAMYOCLONUS MULTIPLEX.

(*Myoclonus*.)

A rare affection characterized by sudden shock-like contractions of a single muscle or group of muscles.

Etiology.—

SEX.—Males most common.

AGE.—Adults.

PREDISPOSING FACTORS not constant: (1) *Shock* may precede onset; (2) *Epilepsy* present in several cases; (3) *Hereditary and family factor* occasional, mainly in cases with epilepsy.

Pathogenesis.—Chief theories:—

1. **AFFECTION OF LOWER MOTOR NEURONS.**—Most probable. Symmetrical spasms suggest anterior horn cells

2. **AFFECTION OF CEREBRAL CORTEX.**—Suggested by frequent epilepsy. Against this theory is the symmetrical occurrence, and spasm in single muscle or asynergic group. No pathological changes in the nervous system are known.

Symptoms.—Main characters of spasms are :—

1. *Limbs* most common. Trunk next. Face rare.
2. *Proximal* muscles commoner than distal, viz.—In arm : deltoid and pectoralis major, also biceps, triceps, and supinator longus. In leg : quadriceps maximus and adductors of thigh.
3. Single muscle, or a portion only, may contract *If a group contracts together*, it consists of muscles which are not supplied by single nerve, cannot be voluntarily contracted together, and have no co-ordinated function
4. Limbs usually not moved, i.e. *no locomotor effect*, and spasms not visible until clothes removed. Rare exceptions in severe cases.
5. *Spasms* usually bilateral and symmetrical, one side generally before the other either constantly or in paroxysms. Contraction very rapid. No constant rhythmicity : consecutive contractions do not usually involve the same muscle, but may do so. Increased by emotion. Usually cease in sleep. Knee-jerks variable.

Voluntary movements and co-ordination not interfered with.

No paresis or muscular atrophy Sensation, electrical reactions, sphincters unaffected

No psychical or mental disturbance

In the familial form (Unverricht's type, myoclonus epilepticus), onset is in childhood, epileptic fits occur, the contractions interfere with and are increased by voluntary movements, and dementia develops.

Diagnosis.—From :—

1. **HUNTINGTON'S CHOREA.**—Dementia develops
2. **HYSTERIA.**—Usually females Stigmata present. May closely simulate myoclonus
3. **TICS.**—Movements purposive

Course.—Chronic. No effect on life.

Treatment.—Palliative Arsenic and tonics. Sedatives may induce habit : hyoscine best Bromides if epilepsy

CHAPTER CLXVIII.

SYPHILIS OF THE CENTRAL NERVOUS SYSTEM.

Syphilis affects the central nervous system in two forms : (1) *Parenchymatous syphilis* : tabes dorsalis and dementia paralytica. (2) *Meningo-vascular or interstitial syphilis* : lesions of vessels, of membranes, and formation of gummata.

Note.—This division is customary and convenient. But both are forms of neurosyphilis with initial lesion in vessels or meninges.

I. PARENCHYMATOUS SYPHILIS.

1. TABES DORSALIS.

(Locomotor Ataxia.)

An affection following syphilis, characterized pathologically by degeneration of posterior columns and posterior roots of cord, and clinically by numerous symptoms, especially inco-ordination, pain, and sensory changes, loss of deep reflexes, and trophic lesions, due to loss of afferent impulses conveyed in degenerated fibres; also by changes in the pupils and special senses.

Etiology.—

SEX.—Males predominate, about 10 to 1 female.

AGE.—Commonest 25 to 45 years.

SYPHILIS is essential factor: presence can be proved in 90 per cent. Tabes or dementia paralytica follows syphilis in not more than 5 per cent of cases, probably considerably less (statistics inconclusive).

Morbid Anatomy.—

CHARACTERISTIC CHANGES IN CORD in late stages are:—

1. SCLEROSIS IN POSTERIOR COLUMNS.—*Macroscopic*: Gray and translucent. *Microscopic*: (a) Degeneration of nerve fibres; (b) Increased neuroglial tissue.
2. ATROPHY OF POSTERIOR NERVE ROOTS.
3. PIA-ARACHNOID THICKENED over dorsal portion of cord.

POSTERIOR ROOTS AND COLUMNS OF CORD.—

BRIEF DESCRIPTION.—The posterior columns contain two sets of fibres: (1) *Exogenous*: cell bodies outside cord in spinal ganglia, fibres form posterior root; first affected in tabes. (2) *Endogenous*: cell bodies inside cord, are collaterals of exogenous fibres; not affected until later stages. The exogenous fibres—i.e., posterior root—divide into two parts on entering cord: (a) *External*: small fibres which enter Lissauer's tract. (b) *Internal*: coarse fibres consisting of: (i) Short fibres, at once entering, and ending about cells in posterior horn; (ii) Medium-length fibres which run variable distance in posterior columns just internal to posterior horn, then enter horn, or end about cells in Clarke's column and anterior horn; (iii) Long fibres ascending columns to nuclei in medulla.

ORDER OF DEGENERATION.—Commences usually in lumbar region. (1) Medium fibres of internal division degenerate first; hence earliest changes are present in Burdach's column in lumbar cord. (2) Long and also short fibres next, whence changes in Goll's column. (3) As condition advances, degeneration spreads along fibres outside cord, and finally to cells in posterior root ganglion. Lissauer's tract and collaterals arising in the cord may also degenerate.

Lumbar region (in marked stages).—All posterior columns affected except two small tracts: (i) Cornu-commissural zone, just dorsal to gray commissure; (ii) Oval area of Flechsig, on each side of median fissure.

Cervical region.—Each root on entering pushes towards centre the fibres from lower roots. As cervical roots are rarely affected, the degeneration is here confined to Goll's columns, formed by fibres from lumbar region.

ESSENTIAL LESION of tabes is a primary progressive degeneration of posterior root fibres *after* entering cord. Increase of neuroglia and changes in root ganglion are both secondary.

CAUSE OF THE DEGENERATION.—Two main theories: (1) Syphilitic inflammation of pia mater on dorsal surface of cord; supposed to pinch fibres at point where a constriction normally occurs on entering cord (now accepted). (2) Syphilitic affection or presence of toxins in posterior lymphatic system; fibres lose the neurilemma sheath on entering cord, and hence are susceptible to toxins (Marie).

OTHER SITES OF DEGENERATION.—

1. **CRANIAL NERVES.**—Most commonly *the optic nerve*.
2. **PERIPHERAL NERVES.**—Rare. Associated with degeneration of anterior horn cells and muscular atrophy, possibly secondary to degeneration of cortex.

Symptoms.—

ONSET.—Most commonly six to fifteen years after syphilis.

THREE STAGES.—(1) Pre-ataxic or incipient; (2) Ataxic; (3) Paralytic.

Symptoms are numerous, and *almost any one may be first to appear or be noted by patient*. Changes of sensation are earliest objective signs. A general summary is given, referred to stages, and then the symptoms are considered individually under the various systems. (The functions of the degenerated tracts afford in general an explanation of the symptoms occurring.)

SUMMARY OF SYMPTOMS ACCORDING TO STAGE.—

1. **PRE-ATAXIC STAGE.**—Any of following may be first noted: (a) *Lightning pains*; (b) *Absence of knee-jerks*, and loss of deep reflexes; (c) *Argyll Robertson pupil*. (The above are the most constant and diagnostic symptoms of tabes.) (d) Optic atrophy; (e) Difficulty in micturition; (f) Romberg's sign. Occasionally: (g) Visceral crises; (h) Ptosis; (i) Paræsthesia. Rarely: Trophic lesions. Impotence not uncommon.
2. **ATAXIC STAGE.**—In addition to above: (a) Ataxic gait; (b) Inco-ordination of movements. Also: Sensory changes; trophic lesions; hypotonia.
3. **PARALYTIC STAGE.**—Advanced inco-ordination.

CONSIDERATION OF SYMPTOMS IN DETAIL.—

1. **SENSORY SYMPTOMS.**—

a. *Lightning pains.*—Most constant symptoms, and often the earliest. Characters: (i) Sharp pains of short duration (few seconds); (ii) Usually in legs; (iii) In bones and muscles rather than joints; (iv) Attacks at irregular intervals, often several weeks; (v) Slight at first, later often intense, but severity has no relation to degree of other symptoms; (vi) May continue in ataxic stage, or may cease (from complete destruction of posterior root).

Tabes Dorsalis—Symptoms, *continued*.

- b. *Prolonged pains* resembling 'rheumatism' not uncommon.
- c. '*Girdle pain*'.—Very common. Sense of constriction.
- d. *Paræsthesia*.—Numbness, tingling, formication. Sensation of *walking on cotton-wool* very common.

Objective sensory changes :—

- e. *Sensory Changes*.—Areas of anæsthesia to pin-prick, temperature, or light touch: 'breast-plate area', perinasal, perianal, tibiæ, inner side of arms: generally bilateral. Hyperæsthesia to light touch. Vibration sense lost in legs. Patient often unaware of presence. May be some hyperæsthesia. May be anæsthesia of tendo Achillis (Abadie's sign) or of ulnar trunk (Biernacki's sign).
 - f. *Alterations in sense of pain*.—Various, mainly in legs—e.g.: (i) Delayed conduction; (ii) Felt as touch only; (iii) Loss of localization. *Extremes* of heat and cold as for pain. These may be earliest signs.
 - g. *Impairment of muscle sense*.—Position in which limbs are placed is not recognized.
 - h. *Loss of deep sensibility*.—Pressure on tendons and bones painless—e.g., squeezing tendo Achillis.
2. ATAXIA.—Due to loss of afferent impulses from muscles, tendons, and joints. Commences in lower limbs. Progress gradual and variable; may advance to *ataxic gait*, and finally to 'paralytic stage', with extreme inco-ordination of all parts, and inability to dress, feed, etc.
- Earliest symptoms: Difficulty in equilibrium when washing face or walking in the dark.
- Chief phenomena :—
- a. *Romberg's sign* (often early).—Difficulty in standing with heels together, *increased on closing eyes*.
 - b. *Ataxic gait*.—Walks bent forward with two sticks. Foot raised high, suddenly thrown out forcibly, and slabbed on ground. Knees hyperextended.
 - c. *Inco-ordination of movements*.—Tests: Approximating tips of forefingers; touching knee with opposite great toe, etc.
3. HYPOTONIA.—(a) Flaccidity of muscles; (b) Abnormal degree of movements at joints. May occur early. Due, as ataxia, to loss of afferent deep impulses.
- Paresis*.—(See OCULAR SYMPTOMS.) Usually slight in limb muscles. Very rarely, paralysis of group of muscles, e.g., peroneal.
4. LOSS OF DEEP REFLEXES, especially *absence of knee-jerk*.—*Early and very important*. Often for years before ataxia. *Loss of ankle-jerk* may precede that of knee-jerk. Test also by 'reinforcement'.
- Superficial reflexes less important: may be increased.
5. PUPIL CHANGES.—(a) '*Argyll Robertson pupils*'—i.e., small pupils, react to accommodation but not to light; present

in at least 70 per cent (*see p. 997*). (b) Pupils often small (spinal myosis). In early stages, often sluggish reactions; may be inequality.

6. OCULAR SYMPTOMS.—

a. *Optic atrophy*.—May be earliest symptom. Usually progresses to total blindness in three to four years. (Primary white atrophy.)

b. *Piosis*.—Unilateral or bilateral. Common early sign.

c. *Paralysis of external ocular muscles*.—Often transient—i.e., occasional diplopia. Of all degrees; rarely, total ophthalmoplegia.

7. SPHINCTERS.—Often affected. Earliest sign: *delay and difficulty in micturition*. Retention later, with danger of cystitis and pyelonephritis. Constipation common, in late stages occasionally incontinence (relaxation of sphincter ani).

8. IMPOTENCE.—Usual.

9. VISCERAL CRISES.—Paroxysms of pain in various organs. Usually in early stages. May be first symptom. Due to irritation of vagus nuclei.

Gastric crisis.—Commonest form. Characters: (a) Sudden onset; (b) Severe epigastric pain (*may be completely absent*); (c) Repeated vomiting, independent of food; (d) Hyperæsthesia in epigastrium, with girdle of anæsthesia, not uncommon; pallor, sweating, small pulse, and may be collapse. Duration: up to several days. Attacks often recur every few weeks. Recovery usually rapid.

Laryngeal crisis.—Not common. Dyspnoea and noisy respiration. May be fatal.

Numerous rare forms.—Renal, rectal, cardiac (angina), nasal (sneezing), urethral, clitoral.

10. TROPHIC LESIONS.—

a. *Perforating ulcer*.—Common site: under great toe. May penetrate to bone. Occasional superficial lesions: *onychia*, herpes, œdema, and local sweating.

b. *Arthropathies* (Charcot's joint).—Characters: (i) *Painless rapid swelling of joint*; no signs of inflammation. (ii) *Commonly knee*; occasionally hip, shoulder, ankle, elbow; usually only one joint. (iii) May subside on first attack, but usually recurs; finally a *flail joint*. Occurs at any period, but rarely pre-ataxic.

Pathology: Increased fluid, thickening of synovial membrane; later, hypertrophy and rarefaction of ends of bones, atrophy of ligaments, erosion of cartilage.

Rare trophic lesions:—

c. Brittleness of bones, and fractures.

d. Muscular wasting; associated with atrophy of anterior horns.

II. CRANIAL NERVES AND SPECIAL SENSES.—(a) *Ocular* (*see OCULAR SYMPTOMS*). (b) *Deafness*: occasionally; from

Tabes Dorsalis—Symptoms, continued.

lesion of auditory nerve or labyrinth; may be vertigo.

(c) *Paralysis of vocal cords*; usually abductors (posterior crico-arytenoids); may also be unilateral atrophy of tongue and palate. Rarely: 5th nerve affected, pain and anæsthesia in area.

Complications.—All rare. *Aneurysm. Cerebral thrombosis* or hæmorrhage from interstitial syphilis of central nervous system. Paranoia and mental changes. Also tabo-paralysis (see p. 981).

Rare Variations.—(1) *Cervical tabes*: commencing in cervical roots and upper limbs. (2) *Juvenile tabes*: in congenital syphilis.

Specific Reactions.—See also SYPHILIS, pp. 234, 235.

WASSERMANN REACTION IN BLOOD.—Positive in 70 per cent.

CEREBROSPINAL FLUID.—(1) *Wassermann reaction*: positive in 60 to 90 per cent. (2) *Lange reaction*: luetic curve in 85 per cent. (3) *Lymphocytosis*: invariable, about 80 cells per cent. (4) *Globulin present* (Nonne-Apelt reaction): 90 per cent.

Diagnosis.—*Argyll Robertson pupils* with one other symptom is conclusive. Most common group is: (1) Lightning pains; (2) Argyll Robertson pupils; (3) Absence of knee-jerks. Note especially: (a) History of syphilis; (b) *Specific reactions* of blood and cerebrospinal fluid (essential in all doubtful cases).
Diagnosis from:—

1. **MULTIPLE (PERIPHERAL) NEURITIS.**—

ALCOHOL, ARSENIC, ETC.—Knee-jerks are absent, but *gait* is 'steppage', not ataxic; muscles are tender, and Argyll Robertson pupils not present. Occasionally, in alcohol, gait is shuffling and resemblance close (alcoholic pseudo-tabes).

DIPHTHERIA.—Note rapid onset and history of illness. Pupil changes may occur; usually react to light and not to accommodation.

DIABETES.—Perforating ulcer with absent knee-jerks may occur.

2. **ORGANIC DISEASE** may be simulated by *visceral crises*. In *gastric crises*: area of epigastric hyperæsthesia more extensive than in gastric ulcer, etc. With recurrent gastric attacks in adults, examine pupils and knee-jerks.

3. **SYPHILITIC MENINGOMYELITIS.**—May closely simulate tabes. Onset at shorter interval after infection, and progress rapid.

4. **CEREBELLAR DISEASE.**—Ataxia unaffected by closing eyes. Knee-jerks variable: no lightning pains, pupillary or sensory changes. Headache, vomiting, and optic neuritis common.

Rarely, difficulty from disseminated sclerosis, Friedreich's disease, subacute combined degeneration, pituitary tabes.

Course and Prognosis.—

COURSE.—Very variable; practically any symptom may be first to appear or to be noticed.

PRE-ATAXIC STAGE.—Duration indefinite; may be many years, or no further advance.

OPTIC ATROPHY.—When present, *ataxia is very rare.*

LIGHTNING PAINS.—Usually diminish in later stages.

MENTAL CHANGES WITH PHYSICAL SIGNS OF TABES.—

When associated, the subsequent course resembles dementia paralytica and not tabes. (*See TABO-PARALYSIS, p. 981.*)

GENERAL PROGRESS may be: (1) Gradual advance. (2) Condition becomes stationary: even after years, a rapid advance may occur, especially after shock or excesses. (3) Rarely, rapid progress in two to three years (young subjects).

RECOVERY never occurs, but there may be improvement.

DURATION.—Usually ten to fifteen years.

PARALYTIC STAGE.—Death from tuberculosis, pneumonia, cystitis, etc.

Treatment.—

1. **GENERAL HYGIENE.**—A quiet regular life: exacerbation follows fatigue or excesses. Occupation continued if possible.

2. **DIET.**—Nutritious. Loss of weight common in tabes.

3. **ANTISYPHILITIC TREATMENT.**—

INDICATIONS.—(a) Onset within five years of infection; (b) No previous course; (c) Syphilitic lesions present; (d) Occurrence or recurrence of tabetic symptoms, e.g., lightning pains.

METHOD.—Bismuth, arsenical, and mercury injections.

4. **SYMPTOMATIC.**—

a. **LIGHTNING PAINS.**—Rest. Analgesics: phenacetin, aspirin, pyramidon, and finally morphia (frequently unavoidable). Hot baths. Counter-irritation to spine (blisters). Division of posterior roots as last resort.

b. **GASTRIC CRISES.**—Rarely controlled except by morphia. Mustard plaster or ice to epigastrium.

c. **LARYNGEAL CRISES.**—Amyl nitrite inhalations.

d. **BLADDER SYMPTOMS.**—Frequent micturition (two-hourly). Catheterize frequently if retention of urine.

5. **FRENKEL'S SYSTEM OF RE-EDUCATION** for inco-ordination. —Inco-ordination is lessened by repetition of a movement. Patient commences by walking along chalked lines, at first straight, later zig-zag and complex; also performs simple movements with hands and legs.

2. DEMENTIA PARALYTICA.

(*General Paralysis of the Insane.*)

An affection following syphilis, characterized pathologically by progressive degeneration of cerebral cortex and meninges, and clinically by mental and physical changes progressing to complete dementia and paralysis.

Etiology.—

AGE.—25 to 45 years.

SEX.—Males predominate.

SYPHILIS.—As in tabes, causal factor in overwhelming majority. Evidence: (1) Frequent admission of infection; (2) Wassermann reaction positive in 90 to 99 per cent; (3) Lymphocytosis in

Dementia Paralytica—Etiology, continued.

cerebrospinal fluid; (4) Immunity to infection by syphilis; (5) Juvenile form in congenital syphilis; (6) Spirochætes present in brain.

MENTAL STRAIN is a factor—i.e., syphilization and civilization. Very rarely simulated in sequels of severe head injuries.

Morbid Anatomy.—**CHARACTERISTIC CHANGES.—**

1. DURA MATER thickened and adherent to skull. Occasionally hæmorrhagic pachymeningitis.
2. PIA-ARACHNOID opaque, thickened, adherent to cortex, and on removal leaves 'worm-eaten' surface.
3. CEREBROSPINAL FLUID increased in subarachnoid spaces.
4. BRAIN CONVOLUTIONS wasted, especially *frontal and middle lobes*. Mainly atrophy of white matter; gray matter reddened from increased vascularity.
5. VENTRICLES dilated; fluid increased; ependyma granular. Granulations on floor of 4th ventricle.

MORBID HISTOLOGY OF BRAIN SUBSTANCE.—

1. ARTERIOLES.—(a) Cellular infiltration of perivascular lymph-spaces; (b) Proliferation of intima and degeneration of media.
2. NEUROGLIA.—Numerous large spider cells. Increase of and fibres.
3. NERVE ELEMENTS.—*Betz's cells* (pyramidal cells of cortex): scanty, marked chromatolysis. Also degeneration and atrophy of cells and fibres.

Changes most marked in anterior and frontal lobes, but may be present diffusely in basal ganglia, pons, medulla, and cerebellum.

SPINAL CORD.—May be some degeneration of posterior columns (as in tabes) and pyramidal tracts secondary to cortical changes.

THEORIES OF ORIGIN.—May be: (1) Primary parenchymatous degeneration of nerve elements, with secondary changes in neuroglia and vessels; (2) Primary change in vessels, with secondary changes in neuroglia and nerve elements.

Symptoms.—

ONSET.—Insidious. Symptoms are *psychical* and *physical*. A *prodromal stage* of psychical changes is often recognizable, of variable duration. Physical signs may be present or precede it. A *fit* may be earliest phenomenon.

PRODROMAL STAGE.—Characterized by early psychical alterations, e.g.: (1) Inattention to business affairs, forgetfulness, rapid mental fatigue; (2) Emotional changes—irritability, outbursts of temper, change of affections; (3) Alcoholic and sexual excesses, and unconcealed contraventions of public morals and customs; (4) Senseless expenditures, onset of exaltation and egoism. *Alcoholism* often complicates picture. May grow fat.

ADVANCED STAGE.—*Psychical changes*. *Delusions of grandeur* and *mental exaltation* marked. Restlessness, sleeplessness, and

excitement. Less often, *acute mania*. Occasionally, *neurasthenia* or *melancholia*, replacing or alternating with delusions or delirium. With all types, progressive dementia and paralysis.

PHYSICAL SIGNS.—Become marked in later stages, but changes in pupils, speech, and knee-jerks, and tremors, usually early.

1. PUPILS.—(a) *Unequal*, irregular, sluggish reactions—common form; (b) Argyll Robertson pupil—less frequent than in tabes. *Optic atrophy* may occur.
2. KNEE-JERKS increased.
3. TONGUE tremulous.
4. SPEECH.—Slow and slurred, syllables often repeated. Changes often early. Tremors of lips and facial muscles during speech.
5. WRITING.—(a) Tremulous; (b) Omissions of words, etc., from mental change.
6. FACIES of complacent stolidity; often with a childish smile.
7. SEIZURES—Usually late in disease, but occasionally early. (a) *Epileptiform attacks*: either general convulsions, Jacksonian, or like *petit mal*. Automatism may occur. (b) *Apoplectiform attacks*: sudden unconsciousness, stertorous respiration, flushing, pyrexia: may be fatal. *Paralyses*—monoplegia, hemiplegia, or aphasia—may follow: are *transient*.
8. PARESIS develops and advances. *Gait* uncertain: often trips on stairs.

SUMMARY.—(1) Mental changes; (2) Characteristic facies; (3) Tremors of tongue; (4) Alterations in speech and writing; (5) Pupil changes; (6) Increased knee-jerks; (7) Seizures; (8) Paralysis; (9) Wassermann reaction positive in blood and in cerebrospinal fluid.

Variations of Type.—

1. TABO-PARALYSIS.—Pathogenesis of tabes and dementia paralytica probably identical, one localized mainly in cord, the other in brain. Intermediate forms occur, viz.: (a) Onset as in tabes; later progress as in dementia paralytica. (b) Mental changes at onset; later progress as in tabes (rarer than preceding type). (c) Symptoms combined from onset—typical 'tabo-paralysis'. Also note: (d) Optic atrophy in tabes commonly followed by mental changes and not by ataxia.
2. PROGRESSIVE DEMENTIA WITHOUT EXALTATION.
3. NEURASTHENIC OR MELANCHOLIC TYPE.
4. CONVULSIVE TYPE.—Numerous seizures, with rapid paresis and dementia.
5. 'JUVENILE DEMENTIA PARALYTICA'.—In congenital syphilis: commoner than tabes. Onset 14 to 18 years.

Specific Reactions.—See also SYPHILIS, pp. 234, 235.

WASSERMANN REACTION IN BLOOD.—Positive in 100 per cent.

CEREBROSPINAL FLUID.—(1) *Wassermann reaction*: positive in 100 per cent. (2) *Lange reaction*: paretic curve. (3) *Lymphocytosis*: invariable, 100 to 200 cells per c.mm. (4) *Globulin* present (Nenne-Apelt reaction).

Dementia Paralytica, *continued*.

Diagnosis.—Early diagnosis very difficult: suggested by psychical changes, and proved by Wassermann reaction. Diagnosis from:—

1. CEREBRAL SYPHILIS.—May simulate closely. Note: (a) Onset earlier after infection, one or two to five years; (b) Progress more rapid; (c) Delusions of grandeur and exaltation rare; (d) Paralysis of cranial nerves, etc., and convulsive seizures more common; (e) Improvement under treatment.
2. INTRACRANIAL TUMOURS (especially in frontal lobe).—Simulation in rare cases. Symptoms of increased intracranial pressure present, and syphilitic reactions negative.
3. MELANCHOLIA AND NEURASTHENIA.
4. LEAD ENCEPHALOPATHY.—Resemblance rare.
5. SEVERE HEAD INJURIES.—Resemblance in rare cases.

SPECIAL DIAGNOSIS.—(1) *Wassermann reaction*: almost invariably positive in both blood serum and cerebrospinal fluid. (2) *Cerebrospinal fluid*: (a) Lymphocytosis; (b) Albumin present.

Course.—Onset insidious. *Gradual progress* until paralytic, demented, incontinent, and bedridden; bedsores common. *Duration* two to five years; rapid if seizures numerous. *Remissions* common; for several months may resume business. *Death* from exhaustion or intercurrent diseases.

Treatment.—Quiet life. With dementia or mental changes, asylum and certification advisable, *preferably early*. Care necessary to prevent bedsores and cystitis. Convulsive seizures: bromide. Mental excitement: sulphonal, or injections of hyoscine (gr. 165). *Antisyphilitic treatment*: usually aggravates condition.

MALARIAL THERAPY.—Value fully established. For mode of infection, etc., see MALARIA, p. 183.

CLINICAL FEATURES. *During febrile course*: Loss of weight; some mental symptoms, e.g., confusion, insomnia.

1. *Unsatisfactory Progress*.—Increasing apathy and dementia during and after course. May be hallucinations.
2. *Satisfactory Progress*.—(a) Mental: Slow progressive improvement, commencing during weeks to months after fever; finally may appear mentally normal. (b) Physical: Weight regained; general condition and facies improve; tremors may disappear; speech, writing, and sphincter control improve; fits diminish; pupils occasionally become normal. (c) Serological reactions: Do not always vary.

TERMINATION OF INFECTION.—As routine, terminated by quinine after 12 paroxysms. Terminate earlier if: (1) Severe debility, gastric, cardiac, or pulmonary symptoms; (2) Persistent pyrexia over 106°; (3) Rapid severe anæmia (2,000,000 reds per c.mm.); (4) Definite jaundice. Excessive pyrexia or quotidian paroxysms often controlled by few doses of quinine. Paroxysms may terminate prematurely spontaneously: provoke further paroxysms by stimulation—e.g., alternate hot and cold douches.

RESULTS OF THERAPY.—Complete remission in 30 per cent; partial in 15 to 30 per cent. (Under former treatments, complete in 3 per cent, partial in 10 per cent.) Mortality under treatment unknown, but probably somewhat above normal.

MODE OF ACTION.—Uncertain. Stated that spirochætes are no longer found in brain.

SUBSEQUENT TREATMENT.—Course of salvarsan or similar preparation: further improvement. Malarial therapy may be repeated.

II. MENINGO-VASCULAR SYPHILIS.

(*Interstitial Syphilis.*)

Pathology.—Three groups of lesions:—

1. **ARTERITIS.**—Syphilitic endarteritis obliterans—viz., proliferation of intima, with thickening of media and adventitia; gummatous changes and perivascular infiltration often coexist (see *SYPHILITIC DISEASES OF ARTERIES*, p. 837).

SPECIAL SITES.—Middle cerebral artery and branches, basilar and vertebral, internal carotid. Lenticulo-striate arteries commonest site.

SYMPTOMS.—*Thrombosis* may result, whence rapid or sudden *aphasia*, *hemiplegia*, or local paralysis, depending on site: either transient or permanent.

2. **MENINGITIS.**—(a) Dura mater (see *HÆMORRHAGIC PACHYMENINGITIS*, p. 1041); (b) Pia-arachnoid or leptomeningitis. The latter is common form of 'syphilitic meningitis': often associated with changes in vessels and gummata. Most common type is a diffuse gummatous meningitis at the base (basal meningitis), a gelatinous formation enclosing all the structures.
3. **GUMMATA.**—May be: (a) Local growths, acting as other tumours. (b) Diffuse: commonly commencing in pia-arachnoid (gummatous meningitis), and tending to spread along vessels into brain tissue.

SPECIAL SITES.—Optic chiasma, interpeduncular space, cranial nerves.

Other forms are: (a) Periostitis or osteitis: in skull not uncommon, in vertebræ very rare. (b) Gumma arising in dura mater: rare.

General Characteristics.—

ONSET.—Comparatively shortly after infection; usually two to five years, may be earlier.

PATHOLOGY.—(1) The various types of lesion frequently coexist—i.e., meningitis, arteries, and diffuse gummatous conditions; (2) They occur at multiple sites.

SYMPTOMS. in accordance with above distribution, have following general characters: (1) Multiple, in various combinations, irregular, and asymmetrical; (2) Often incomplete and transient—disappear, reappear, and others occur. Syphilis is suggested by a combination and sequence of symptoms inexplicable by a single lesion, and by the variability and irregularity

Meningo-Vascular Syphilis—General Characteristics, *continued*.

of their occurrence; the individual symptoms are identical with those due to other causes. The pathological lesions are usually more extensive than the symptoms suggest.

Specific Reactions.—*See also SYPHILIS*, pp. 234, 235.

WASSERMANN REACTION IN BLOOD.—Positive in 80 to 90 per cent.

CEREBROSPINAL FLUID.—(1) *Wassermann reaction*: positive in 65 per cent. (2) *Lange reaction*: luetic curve. (3) *Lymphocytosis* invariable. (4) *Globulin* absent.

General Diagnosis.—Depends upon: (1) Distribution and variability of symptoms, especially cranial nerve lesions; (2) History of syphilis; (3) Specific reactions; (4) Results of treatment.

Clinical Groups.—The most important are. (1) *Intracranial or cerebral syphilis*: (a) Meningitis, basal and cortical; (b) Thrombosis; (c) Gumma. (2) *Spinal syphilis*: (a) Chronic meningomyelitis; (b) Acute myelitis. Numerous rare clinical types occur. (3) *Cerebrospinal syphilis*: a basal meningitis may spread into the cervical cord, or be associated with lesions in the lumbar zone. Such, and other, combinations constitute cerebrospinal syphilis.

CEREBRAL OR INTRACRANIAL SYPHILIS.

Onset.—Chronic: rarely acute.

Early and Prodromal Symptoms (absence of all is rare).—

1. **HEADACHE.**—Severe: *worse at night*. May be local, with tenderness on pressure.
 2. **INSOMNIA.**—Often due to headache.
 3. **MENTAL APATHY AND ATTACKS OF SOMNOLENCE.**
- VERTIGO, DEFECTIVE MEMORY, IRRITABILITY may be present.

Varieties.—**CORTICAL MENINGITIS.**—

LOCAL SYMPTOMS, depending on site of lesion. Note:—

1. *Headache.*—Often frontal or parietal, local tenderness on pressure.
2. *Mental Symptoms* common: forgetfulness, indistinct speech, dementia.
3. *Convulsions*, when motor cortex affected, resembling epilepsy except for sequel of:
4. *Aphasia, monoplegia, hemiplegia*, etc.; often transient.

BASAL MENINGITIS.—**CHIEF PHENOMENA.**—

1. *Headache*: severe, especially nocturnal. Vertigo, vomiting attacks common.
2. *Psychical Changes* frequent: somnolence, stupor, excitement, or delusions.
3. *Epileptiform Attacks* may occur: of all varieties; hemiplegia may follow.

4. *Cranial Nerve Paralysis*, especially second, third, and sixth. Very important. Note: (a) Optic nerve: may be—(i) Optic neuritis, with subsequent atrophy and blindness; (ii) Hemianopia of varying extent, from involvement of chiasma or tract. (b) Third nerve: very common; affection usually partial—e.g., ptosis, paralysis of single muscles, pupil changes. (c) Sixth nerve: very common; usually unilateral; *diplopia* results. (d) Fourth nerve: less frequent. Rarely, complete ophthalmoplegia. Less commonly, but not infrequent: (e) Seventh and eighth nerves: usually together. (f) Fifth nerve: usually sensory portion (g) Tenth, eleventh, and twelfth nerves; when meningitis is spreading towards cord; unilateral paralysis of tongue, palate, vocal cords; also vagus disturbances. A unilateral *bulbar paralysis* suggests syphilis.

COURSE.—Usually remissions and relapses over several years. May be fatal within a year, and even during course of treatment.

ARTERIAL THROMBOSIS, GUMMA.—See PATHOLOGY, p. 983.

PSEUDO-GENERAL PARALYSIS, SYPHILITIC DEMENTIA.

—Symptoms in diffuse cerebral lesions may closely resemble dementia paralytica (q.v.). Cranial nerve paralyzes and other indications of widespread lesions usually appear.

SPINAL SYPHILIS.

Onset.—Usually within five years of infection: may be during period of eruption. Chronic forms sometimes after much longer interval.

Varieties.—

CHRONIC MENINGOMYELITIS—Commonest variety of spinal syphilis. Lesion usually in dorsal region. Duration of progress variable: few weeks to months.

SYMPTOMS.—

Initial symptoms, due to meningitis: pain in back, especially nocturnal; pain in root areas, and paræsthesias.

On extension to cord, symptoms of incomplete transverse myelitis:—

Sphincters early affected: retention of urine. *Impotence* not infrequent.

Paraplegia, partial or complete; rapidity of onset variable.

Sensory changes variable: partial anæsthesias, often 'dissociated'.

Deep reflexes usually increased. Plantar reflex often extensor.

Signs of cerebral syphilis (cranial nerve paralyzes, etc.) often present or precede.

COURSE.—Recovery may be partial, rarely complete. May become stationary. Death from bedsores, cystitis and pyelonephritis, intercurrent diseases; in rapid forms in six to twelve months.

Spinal Syphilis—Varieties, continued.

ACUTE MYELITIS.—Onset, six months to five or more years after infection. Due to vascular disease and thrombosis resulting in degeneration and softening.

ONSET.—(1) May be rapid: few hours or days. (2) There may be premonitory symptoms: headache, vertigo, diplopia, difficulty in micturition, etc., due to cerebral changes. Root symptoms (radiating pains, paræsthesia, etc.) are absent, as meninges are unaffected.

SYMPTOMS of transverse myelitis develop:—

Paraplegia, usually spastic, but flaccid in complete transverse myelitis.

Deep reflexes increased or diminished.

Sphincters usually paralysed.

Sensory changes: commonly anæsthesia up to, and hyperæsthesia at, level of lesion; generally partial.

COURSE.—(1) Flaccid type: may become spastic in few days, but if persistent, generally rapidly fatal. (2) Spastic type: commonly improves, often markedly, but complete recovery rare. *Bedsores*, *cystitis*, and *pyelonephritis* common.

VARIOUS CLINICAL TYPES.—Nearly all spinal cord diseases are simulated occasionally by spinal syphilis, owing to meningitis, vascular lesions, and resulting degenerations in various sites, e.g.:—

1. **SYPHILITIC PSEUDO-TABES.**—Rare. Onset earlier and progress more rapid than tabes, and improvement under treatment.
2. **DISSEMINATED SCLEROSIS.**—Nystagmus and intention tremor absent.
3. **SYRINGOMYELIA.**
4. **ERB'S SYPHILITIC SPINAL PARALYSIS** (p. 954).

VARIOUS PATHOLOGICAL LESIONS.

MENINGITIS.—Gummatous mass enclosing cord, usually small area. Symptoms as in non-syphilitic meningitis, but cranial nerve paralyse, etc. (cerebrospinal syphilis), often present.

VERTEBRÆ.—Rarely affected: periostitis, osteitis, gumma. Symptoms as in tumour or caries.

ISOLATED GUMMA OF SPINAL CORD AND MEMBRANES.—Very rare.

Treatment of Interstitial Syphilis of the Central Nervous System.—See **SYPHILIS**.

CHAPTER CLXIX.**DISEASES OF THE CRANIAL NERVES.****I. OLFACTORY NERVE.**

Lesions may occur at any site from nasal mucous membrane (especially anosmia) to cerebral centres in hippocampus and uncinate gyrus.

Anosmia (loss of sense of smell).—Causes:—

1. **AFFECTIONS OF THE OLFACTORY MUCOUS MEMBRANE.**
—Common in chronic nasal catarrh, polypi, etc. Transient in acute catarrh, and after strong odours.

2. LESIONS OF THE BULB OR TRACT.—E.g., head injuries, tumours, meningitis, caries of bone.

Parosmia (perversion of sense of smell).—Occurs in: (1) Insanity—not uncommon; (2) Aura of epilepsy—rarely; (3) Hysteria. Rarely in head injuries, tumours of hippocampus.

Hyperosmia (increased sensitiveness).—Occasionally in hysteria; usually with parosmia.

Tests of Smell.—Essential oils, e.g., cloves, peppermint. Ammonia stimulates the fifth nerve.

II. OPTIC NERVE AND TRACT.

1. OPTIC NEURITIS AND RETINITIS.

Optic Neuritis, or Papilloedema.

GENERAL APPEARANCE.—

Disc.—(1) *Pink colour* (from dilatation of small vessels); (2) *Edges blurred*; (3) *Disc swollen*; (4) *Physiological cup filled in*; (5) *Vessels hidden in places* by exudation; (6) *Vessels appear 'kinked'* at edge of disc (from passage over swelling).

VEINS IN RETINA distended and tortuous.

ARTERIES small.

Notes.—*In early stage*: disc pink and edges blurred and striated. *Swelling of disc*: on passing from retina to disc in examination, + lenses are necessary. (N.B.: 3 D = 1 mm.)

VISION.—Often unimpaired. Later, blurred.

SEQUEL.—If slight, may recover. If severe, secondary optic atrophy may develop, with impaired vision.

'Optic neuritis' is probably always due to rise of intracranial pressure causing obstruction immediately proximal to disc (papilla); hence 'papillitis' or papilloedema is correcter term.

GENERAL APPEARANCE.—

1. **HÆMORRHAGES**.—In course of vessels. Colour bright-red to black, depending on age. Shape and size vary; may be flame-shaped.

2. **WHITE PATCHES**.—Two types: (a) Glistening white spots, arranged as '*stellate figure*' round macula, or fan-shaped; from crinkling of the retina due to oedema (Marcus Gunn). (b) 'Woolly' white patches scattered over retina; origin may be (i) fibrinous exudation, (ii) fatty degeneration in retina, (iii) clumps of leucocytes, (iv) sclerosis of retina.

Note.—'*Stellate figure*' occurs mainly in (1) albuminuria, (2) syphilis.

Diffuse cloudiness of retina common, from serous effusion.

Causes and Varieties of Optic Neuritis and Retinitis.—Optic neuritis and retinitis may occur together or separately. The medical causes of the two conditions are given below, and the differences noted.

Optic Neuritis and Retinitis—Causes and Varieties, *continued*.

1. INTRACRANIAL DISEASE.—Increased intracranial pressure causes *optic neuritis*. *Retinitis absent*.

a. INTRACRANIAL TUMOURS.—Produce 'choked disc' (great swelling of nerve head). *Frequency* varies with site of tumour: in cerebrum, usually present; in corpora quadrigemina, always; in cerebellum, in 90 per cent; in pons, rarely; in medulla, very rarely; hence absence does not negative tumour. *Intensity* varies with rapidity of growth rather than size of tumour. *Onset* may be unilateral, and most advanced on side of tumour, but distinction is difficult. *Subsidence* after decompression often rapid.

b. CEREBRAL ABSCESS.—Often absent.

c. MENINGITIS.—Most frequent in basal meningitis—e.g., syphilitic. In cerebrospinal meningitis not common. In tuberculous meningitis, duration rarely sufficient to become severe. *Choroidal tubercles* are distinguished from *retinitis* by: (i) Size; (ii) Not crossed by choroidal vessels; (iii) Indistinct edges; (iv) Absence of pigment (distinguishes from choroiditis).

d. SYPHILIS OF THE NERVOUS SYSTEM.—Retinitis and choroiditis may also occur.

e. HYDROCEPHALUS.

2. TOXIC CONDITIONS.—

a. ALBUMINURIC RETINITIS.—*Occurrence*: especially chronic interstitial nephritis; also nephritis of pregnancy. *Variations*: optic neuritis often present, may predominate; or retinal hæmorrhages may be most marked. *Common characteristics*: (i) Stellate or fan-shaped figure marked; scattered white spots ('cotton-wool') due to exudation and fatty degeneration; (ii) Flame-shaped hæmorrhages; (iii) Arteries small, with distinct white line, rigid, and constrict veins where they cross; veins engorged. *Vision*: often definitely affected. (Blindness in albuminuria may be uræmic, with no fundus changes.) *Sequelæ*: Severe optic neuritis may progress to atrophy; in pregnancy may subside, even when severe.

b. DIABETIC RETINITIS.—Usually elderly patients with chronic diabetes. *Note*: (i) No stellate figure; (ii) Optic neuritis absent (or rare); (iii) Round hæmorrhages and scattered white patches numerous; hæmorrhage into vitreous may cause permanent opacities. Diagnosis from albuminuric retinitis usually uncertain.

Other ocular conditions in diabetes: Cataract, toxic amblyopia, retrobulbar neuritis and its sequelæ.

3. BLOOD DISEASES.—*Retinitis*: optic neuritis very rare.

a. LEUKÆMIA.—Characters: (i) Eye-ground pale (not invariably); (ii) Hæmorrhages numerous, and yellow patches; (iii) Vessels dilated; (iv) No stellate figure.

b. PERNICIOUS ANÆMIA.—Characters: (i) Disc and eye-ground very pale; (ii) Hæmorrhages with white centre; (iii)

Vessels distended, especially veins; (iv) White spots scanty, no stellate figure.

In simple anæmia.—Blindness occasionally occurs after large hæmorrhage, usually after few days' interval; generally no changes in fundus; rarely permanent. In chronic anæmia, very rarely, optic neuritis occurs; improves with treatment of cause.

4. SPINAL DISEASES.—Very rare. Optic neuritis recorded occasionally in myelitis (? toxic), and cervical caries and tumours (? interference with cerebrospinal fluid).
5. RETROBULBAR NEURITIS.—Optic neuritis may follow.
6. VARIOUS DISEASES OF THE RETINA.
7. VARIOUS RARE CAUSES OF OPTIC NEURITIS.—Influenza, scarlet fever, lead, alcohol, and other causes of multiple neuritis. Sepsis in accessory sinuses.
8. ARTERIOSCLEROTIC RETINITIS.—Often unilateral. In *hypermetropia* congestion of the discs occurs.

2. OPTIC ATROPHY.

May be *primary*, or *secondary* to preceding optic neuritis.

Primary Optic Atrophy.—

APPEARANCE.—(1) Edges of disc sharply defined; (2) Physiological cup deep and *lamina cribrosa visible*; (3) Arteries small or normal; (4) Colour of disc white or grayish. Pupil dilated: does not react.

CAUSES.—(1) *Tubes*: Disc gray (progresses to blindness). (2) Dementia paralytica. (3) *Disseminated sclerosis*: Disc white (never complete blindness). (4) *Excesses*: Alcohol, tobacco, and sexual, especially together. (5) Certain drugs, especially atoxyl, methyl alcohol, rarely lead. Occasional forms: (5) *Hereditary* (Leber's disease); exhibited by males, and transmitted by females; rare. (6) Trauma to the temples. (7) Severe anæmia from repeated hæmorrhages: very rare. *Retrobulbar neuritis* may result in primary, or less often secondary, atrophy.

Secondary Optic Atrophy.—

APPEARANCE: (1) Edges of disc blurred and irregular; (2) Physiological cup filled in; (3) Arteries small, often white line at side, from previous disease; (4) Colour of disc dead white.

CAUSES as in optic neuritis.

Symptoms.—(1) Vision impaired; (2) Field of vision diminished from periphery; (3) Colour vision fails, red and green first.

3. RETROBULBAR NEURITIS.

Inflammatory and other lesions of the optic nerve proximal to nerve head.

Occurrence.—

1. EXTENSION FROM LOCAL SEPSIS.—E.g., ethmoidal sinus (teeth doubtful). Unilateral or bilateral. Optic neuritis common. Recovery fair. Avoid operation in acute stage.

Retrobulbar Neuritis—Occurrence, *continued*.

2. **DISSEMINATED SCLEROSIS**.—Foci in optic nerve. Onset may be sudden; unilateral or bilateral. Causes transient amblyopia. Some optic atrophy follows: never ends in complete blindness.
3. **SYPHILIS**.—Diffuse gumma. Usually unilateral. Often ends in complete blindness (if thrombosis), but may recover.
4. **DIABETES**.—Onset with central scotoma. Ends in blindness with optic atrophy.
5. **TOBACCO**.—Causes misty vision and central scotoma ('tobacco amblyopia'). Complete recovery if tobacco stopped.
6. **WOOD ALCOHOL, ETC.**—May be complete blindness.

Local Signs.—Pupil usually dilated: reaction slight, may contract to light and then dilate. Optic neuritis develops if lesion near disc, and, with this, pain in eye.

Disturbances of Vision without Changes in the Fundus.—Some are functional; others are due to retrobulbar neuritis. Examples:—

1. **TOXIC AMAUROSIS**.—Especially in *uræmia*, with or without convulsions. Other conditions: diabetes, loss of blood, lead.
2. **TOBACCO AND QUININE AMBLYOPIA**.
3. **HYSTERIA**.—Helical restriction of fields of vision, and changes in colour fields, etc. Also other functional conditions.
4. **NYCTALOPIA** (night blindness).
5. **CONGENITAL COLOUR BLINDNESS**.

4. AFFECTIONS OF OPTIC CHIASMA.

Cause of Lesions.—Tumours of *pituitary gland*, cerebral syphilis; rarely hydrocephalus.

Symptom.—*Heteronymous hemianopia*. Distribution depends on site of lesion:—

1. **CENTRAL PORTION OF CHIASMA AFFECTED** (most common).—Bitemporal hemianopia results (fibres affected from nasal half of each retina). Extent progresses to total blindness with increase of lesion.
2. **OUTER SIDE OF CHIASMA AFFECTED** (very rare).—Nasal hemianopia results: extremely rarely bilateral (tabes, calcification of internal carotid arteries).

5. AFFECTIONS OF OPTIC TRACT.

Cause of Lesions.—Tumours from base of brain; rarely hæmorrhage.

Symptom (in unilateral lesion).—(Bilateral) homonymous or lateral hemianopia, partial decussation of fibres having taken place at chiasma. Thus, a lesion of the *right* tract causes inexcitability of right half of each retina, whence blindness on the *left* side of body.

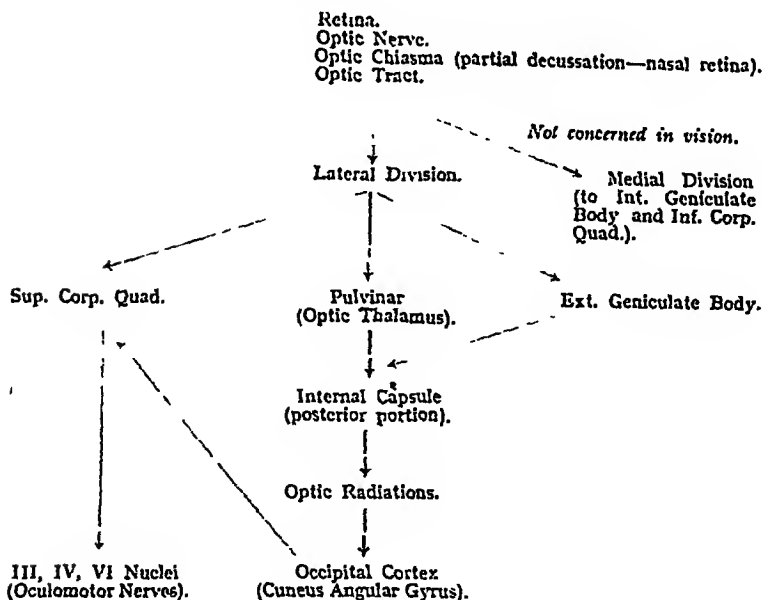
6. AFFECTIONS BETWEEN THE OPTIC TRACT AND THE VISUAL CENTRES.

The Visual Paths.—The optic tract crosses the crus or cerebral peduncle, and at the posterior end of the optic thalamus divides into two parts:—

1. **MEDIAL DIVISION.**—Contains fibres from the 'inferior (Gudden's) commissure'; passes to the median geniculate body and posterior corpus quadrigeminum. Is not connected with retina or concerned with vision.
2. **LATERAL DIVISION.**—Sends fibres to (a) the lateral geniculate body, (b) pulvinar (optic thalamus), (c) anterior corpus quadrigeminum. From the first two, fibres run in the posterior portion of the internal capsule and the optic radiations to the occipital cortex. *The anterior corpora quadrigemina* are connected by fibres with the nuclei of the third, fourth, and sixth nerves, thus connecting the retina with the nerves controlling eye movements; fibres also run from the occipital cortex to the anterior corpora quadrigemina. The portions of the cerebral cortex concerned with vision are (a) the *cuneus* and *lingual gyrus*, and (b) higher centres in the *angular and supramarginal gyrus*.

The lateral geniculate body is apparently connected with the macula lutea, and lesions always affect vision.

CHART OF VISUAL PATHS.



Affections between the Optic Tract and the Visual Centres, *continued*.

Symptoms and Localization.—*Lesions of the visual path between optic chiasma and cerebral cortex at any point produce lateral hemianopia.* Localization must rely on:—

1. The presence of symptoms due to simultaneous lesions of other fibres.
2. The partial character of the hemianopia, as the fibres separate. Behind the lateral geniculate body it is rarely complete.
3. Wernicke's hemiopic pupillary reaction. The pupil reflex takes place through the arc—retina, optic nerve, chiasma, and tract, to anterior corpus quadrigeminum, hence by Meynert's fibres to third nucleus, and by third nerve to ciliary ganglion, ciliary nerves, and iris; the centre is probably in the ciliary ganglion. For the test: A beam of light is directed on the non-functioning portion of the retina; if the pupil contracts, the lesion must be beyond the arc.

SITES OF LESION AND LOCALIZING SYMPTOMS.—Lateral hemianopia is present in all cases.

1. **OPTIC TRACT TO LATERAL GENICULATE BODY.**—Pupil reflex absent. Bilateral homonymous hemianopia.
2. **INTERNAL CAPSULE (posterior portion).**—*Hemianæsthesia* not uncommon (sensory fibres close), or hemiplegia (e.g., *left* internal capsule lesion produces right hemiplegia and right lateral hemianopia). Pupil reflex normal.
3. **OPTIC RADIATIONS.**—Hemianopia less complete. Pupil reflex normal.
4. **CUNEUS AND LINGUAL GYRUS.**—Hemianopia still less complete: may be quadrantic. Bilateral disease causes total blindness. Pupil reflex normal.
5. **ANGULAR GYRUS.**—Results usually not in hemianopia but in *crossed amblyopia*, a concentric diminution of fields of vision, greater on side opposite to lesion. *Mind-blindness* may occur, failure to recognize nature and use of objects. Pupil reflex normal.

Hemianopia occurs also in *migraine* and *hysteria*.

III. THE OCULOMOTOR NERVES (THIRD, FOURTH, AND SIXTH).

Anatomy.—

THIRD NERVE (Oculomotor).—*Origin*: Nuclei in floor of aqueduct of Sylvius. Emerges at inner side of crus, just in front of pons. *Distribution*: (1) Superior branch: levator palpebræ and superior rectus. (2) Inferior branch: internal and inferior recti and inferior oblique. (3) Constrictor of iris. (Each muscle has a separate nucleus, which may alone be affected by lesions.)

FOURTH NERVE (Trochlear).—*Origin*: Nucleus in floor of aqueduct of Sylvius. Nerve decussates in valve of Vieussens and supplies muscle on opposite side to nucleus. *Distribution*: Supplies superior oblique muscle.

SIXTH NERVE (*Abducent*).—Origin: Nucleus in floor of fourth ventricle. Emerges between pons and medulla. *Distribution:* Supplies external rectus muscle. Sends fibres to third nucleus (*see* CONJUGATE DEVIATION, p. 994); also has connections with eighth nucleus, concerned in equilibrium.

General Symptoms of Paralysis of External Ocular Muscles.—

1. **LIMITATION OF MOVEMENT.**—In direction of paralysed muscle. Later, affected and increased by contraction of unopposed antagonistic muscle.
2. **STRABISMUS OR SQUINT.**—Visual axes not in correspondence: (a) *Convergent*, when axes cross (e.g., paralysis of external rectus); (b) *Divergent*, when axes diverge (e.g., paralysis of internal rectus).
Primary deviation is deviation of axis of affected eye from parallelism with that of normal eye.
3. **SECONDARY DEVIATION.**—Method of demonstration: Patient looks at object in position involving use of affected muscle (e.g., right internal rectus). Sound (left) eye is now covered from sight of object, when it moves further outwards: due to the excessive nerve effort to contract the weak muscle affecting both the two muscles which act together (right internal and left external rectus). Absent in spasmodic strabismus (ordinary squint).
4. **ERRONEOUS PROJECTION.**—Example: Paralysis of right internal rectus; object placed to left of mid-position. On looking at object, nerve effort to move eye is greater than normal, and brain is deceived as to amount of movement; hence on attempting to touch object, finger passes to *left* of it.

Giddiness (ocular vertigo) is often present, since maintenance of equilibrium partly depends on estimation of relations of surrounding objects.

5. **DIPLOPIA.**—True image seen by sound eye and false by affected eye: (a) *Simple* or *homonymous* diplopia: in convergent strabismus. False image on same side as the (affected) eye by which it is seen. (b) *Crossed* diplopia: in divergent strabismus

Werner's 'Artificial Memory' assists identification of affected muscle. Place coloured glass before one eye to identify images during examination.

Lesions of the Motor Nerves of the Eyeball.—Symptoms vary:

- (1) According as the nerves are affected together, separately, or partially (especially the third); (2) With the site of affection. This site may be:—

- a. **NUCLEAR OR SUPRANUCLEAR**, from nucleus to cortex. Usually more than one nucleus is involved. Affects movements rather than individual muscles, e.g., conjugate deviation (*see below*). Nuclear lesions usually arise from chronic degenerations; supranuclear lesions from hæmorrhage, etc.

The Oculomotor Nerves—Lesions, *continued*.

- b. NERVE BETWEEN NUCLEUS AND EMERGENCE AT BASE OF BRAIN, e.g., lesion of crus (third nerve), pons (sixth nerve). Other structures also affected. Cause: tumour, gumma, basal meningitis.
- c. NERVE IN COURSE AT BASE OF BRAIN.—Cause: meningitis, gumma, aneurysm, tumour; also, in third nerve, neuritis from diphtheria or tabes. Nerves often affected separately or partially.
- d. NERVE IN OR NEAR ORBIT.—Fractures, disease of bones, thrombosis of cavernous sinus, etc. May affect all nerves. Total *ophthalmoplegia* results if all nerves are completely paralysed.

THIRD NERVE.—Lesions cause either paralysis or spasm.

CAUSES.—(1) Meningitis, etc., at base, or in substance of brain, especially syphilis; (2) Diphtheria, tabes.

COMPLETE PARALYSIS.—Superior oblique and external rectus unaffected; hence eye can be moved out and slightly down and outwards. Other symptoms are: (1) Divergent strabismus; (2) Ptosis; (3) Diplopia; (4) Pupil dilated, no reaction to light, or power of accommodation.

PARTIAL PARALYSIS more common. Various types, especially *ptosis*, or internal ocular muscles only.

LESION OF ONE CRUS may produce: (1) Paralysis of face and limbs on opposite side; with (2) Paralysis of third nerve on same side, often partial, e.g., *ptosis*. (See p. 1016.)

Recurrent Oculomotor Paralysis.—Rare condition. Attacks accompanied by headache and vomiting: related to migraine.

FOURTH NERVE.—Rarely affected alone.

PARALYSIS causes *diplopia* on looking downwards and inwards, also slightly deficient movement in same direction, but difficult to recognize; head is inclined downwards, with chin towards sound side.

SIXTH NERVE.—Injury at base of brain common, owing to long course.

PARALYSIS produces: (1) Movement outwards lost or impaired; (2) Convergent strabismus; (3) Diplopia towards affected side; (4) Head turned towards affected side.

'CONJUGATE DEVIATION'.—From the *nucleus* of the sixth nerve, fibres for the supply of the opposite internal rectus run to the nucleus of the opposite third nerve and then in its trunk. Hence: (1) In a nuclear lesion of the sixth nerve, both eyes deviate (conjugate deviation) to the opposite side, looking away from the lesion; (2) In a supranuclear lesion (see CEREBRAL HÆMORRHAGE, p. 1029), eyes look towards the lesion; (3) If lesions produce spasm (less common) and not paralysis, directions are reversed.

LESIONS OF THE PONS.—The sixth *nucleus* is in propinquity to the fibres of the seventh nerve. Hence a lesion of one side of the pons may produce: (1) Facial paralysis on the same side; with (2) Conjugate deviation to the opposite side. (See p. 1016.)

Lesions of the Internal Ocular Muscles.—The muscles are: (1) *Ciliary muscle*, concerned in accommodation (supplied by third nerve); (2) *Constrictor of the iris* (third nerve); (3) *Dilator of the iris* (cervical sympathetic).

✓ CYCLOPLEGIA.—Loss of power of accommodation from paralysis of ciliary muscle. Distant objects clear, near objects indistinct (corrected by convex lenses). Occurs in: (1) *Diphtheria*—common; (2) *Tabes*—rarely; (3) *Degeneration of nucleus*.

IRIDOPLEGIA.—Occurs in following forms:—

1. **LOSS OF REFLEX TO LIGHT.**—Due to interruption of arc (for path, see WERNICKE'S HEMIOPIIC REACTION, p. 992).
2. **ACCOMMODATION IRIDOPLEGIA.**—Usually with cycloplegia, e.g., in diphtheria.
3. **LOSS OF SKIN REFLEX.**—On pinching skin of neck, pupil normally dilates from stimulation of cervical sympathetic; absent occasionally in lesions of cervical sympathetic, cervical cord, or medulla.
4. **PARALYSIS OF DILATOR OF IRIS.**—Small pupils occur in spinal disease, e.g., spinal myosis in tabes. Unilaterally, in lesions of cervical sympathetic—e.g., in brachial plexus injuries—with narrowing of palpebral fissure.

Ophthalmoplegia Externa.—Paralysis of the external muscles of the eye: slow, chronic, bilateral, and may progress to completeness. *Cause*: A chronic degeneration of the nuclei; may be associated with bulbar paralysis or progressive muscular atrophy; rarely, tabes, tumours, basal meningitis (syphilitic). *Symptoms*: Usually commences with ptosis; finally no movements.

OTHER VARIETIES.—*Acute forms rare*: (1) Vascular lesions, often syphilitic; (2) Inflammation (polio-encephalitis superior, often fatal). Rarely in diphtheria and other causes of multiple neuritis.

Ophthalmoplegia Interna.—Progressive paralysis of internal ocular muscles, usually with ophthalmoplegia externa; together form *total ophthalmoplegia*

Ptosis.—Origin may be:—

1. Congenital.
2. Lesions of the third nerve. Often with affection of other ocular muscles, and frequently due to syphilis. Also in cerebral lesions.
3. *Hysteria*: bilateral ptosis
4. Lesions of cervical sympathetic nerve. Ascribed to paralysis of unstriated muscle in upper lid. Pupil is contracted. (Pseudo-ptosis.)
5. *Myasthenia gravis*.
6. 'Matutinal ptosis': for few hours after waking, in delicate women.
7. Muscular wasting of facial muscles.
8. Pain, as in migraine (transient).

Nystagmus.—Rapid involuntary bilateral rhythmical oscillations of the eyes. Direction of movement lateral, rarely rotary or vertical. Usually absent in mid-position, occurring when eyes are moved

The Oculomotor Nerves—Nystagmus, *continued*.

laterally. Particularly connected with disease in mid-brain and cerebellum. (See p. 1004.) Common conditions:—

1. Tumours of cerebellum, pons, and corpora quadrigemina (not of cerebral cortex).
2. Disseminated sclerosis.
3. Friedreich's ataxia.
4. Disturbances of semicircular canals—c.g., Ménière's disease.
5. 'Head-nodding' in children: occurs in mid-position of eyes.
6. Albinos.
7. Coal-miners.
8. Opacities of cornea, errors of refraction: occasionally.

Pupils: Abnormalities of Size and Shape.—

SIZE OF PUPIL depends upon: (1) Oculomotor nerve (constrictor of iris muscle); (2) Cervical sympathetic nerve (dilator of iris muscle); (3) Spiral arteries of iris—as these straighten under high pressure, the pupil diminishes, and vice versa. *Dilatation* results from either (a) paralysis of third nerve, (b) irritation of cervical sympathetic, or (c) low blood-pressure. Conversely, for *contraction*, (a) irritation of third nerve, (b) paralysis of cervical sympathetic, and (c) high blood-pressure.

DILATED PUPILS (especially with low blood-pressure).—Causes:—

1. Anæmia.
2. Aortic regurgitation.
3. Increased cerebral pressure: tumours, hæmorrhage, abscess, meningitis.
4. Drugs: atropine, cocaine, alcohol. Also daturine, duboisine.
5. Emotion.
6. Asphyxia.
7. Stimulation of cervical sympathetic nerve.

CONTRACTED PUPILS (especially in high blood-pressure).—Causes:—

1. Chronic nephritis and arteriosclerosis.
2. Irritation of third nerve nucleus: hæmorrhage in pons.
3. Spinal myosis—c.g., in tabes. Lesion in pons below third nerve nucleus interrupting dilator fibres from cervical sympathetic.
4. Drugs: morphia, eserine, pilocarpine.
5. Venous congestion—c.g., in bronchitis, whooping-cough. Also occur *physiologically* in bright light, in accommodation, and during sleep.

IRREGULAR PUPILS.—Sequel to iritis.

UNEQUAL PUPILS.—Causes:—

1. Dementia paralytica.
2. Third-nerve lesion, paralysis or irritation: gummatous meningitis.
3. Thoracic aneurysm (q.v.).
4. Cervical sympathetic lesion, paralysis or irritation: trauma to brachial plexus; rarely tumours in neck, pleural diseases.

Also: glass eye, atropine in one eye.

ARGYLL ROBERTSON PUPIL.—*Small pupil* (spinal myosis); reacts to accommodation but not to light; occurs only in syphilis, especially in tabes, less commonly in dementia paralytica. Pupil reacting to accommodation but not light (size normal) occurs also in encephalitis, diphtheria, as hereditary condition, and rarely in other lesions: probably due to interference in tract from superior corpus quadrigeminum to anterior nucleus of third nerve nucleus.

Note.—Reaction to 'accommodation' as usually tested is correctly reaction to convergence.

The Myotonic Pupil.—Mainly in young females; normal health; no relation to syphilis.

FEATURES—

1. To CONVERGENCE ('accommodation').—Contraction very slow, pupil may finally become very small; relaxation very slow.
2. To LIGHT.—No reaction.
3. OFTEN UNILATERAL.—Affected pupil usually larger than the other.
4. KNEE-JERKS.—May be absent; often unilateral.

Paralysis of the Cervical Sympathetic (*Horner's Syndrome*).—

CERVICAL SYMPATHETIC FIBRES FOR THE EYE.—(1)

Centre near oculomotor nuclei, by tecto-spinal tract to cervical cord; (2) Emerge as white rami communicantes from C.8 and D.1 segments, (3) By cervical sympathetic trunk, carotid plexus, ophthalmic plexus, and lenticular ganglion to eyeball and orbit.

PARALYSIS—Results: (1) Retraction of eyeball, enophthalmos; (2) Narrowing of palpebral fissure (ptosis); (3) Contraction of pupil. Permanent.

OCCURRENCE.—(1) Lesions of cervical cord, especially involving C.8 and D.1; (2) Lesions of cervical sympathetic trunk—trauma, growths, cervical ribs; (3) Intracranial syphilis.

IV. FIFTH NERVE.

(*Nervus Trigemimus*.)

Organic Lesions.—

1. SUPRANUCLEAR.—Occurs rarely in lesions of posterior portion of internal capsule; hence usually anæsthesia of limbs as well as face on opposite side. Motor nerve escapes (centres bilateral).
2. NUCLEAR: IN PONS.—From hæmorrhage, thrombosis, or tumour; rare—bulbar paralysis, disseminated sclerosis, syringomyelia. Sensory changes: Hemianæsthesia of face on same side; if mesial fillet also involved, 'crossed' hemianæsthesia, viz., limbs also on opposite side. Is often bilateral.
3. INFRANUCLEAR: AT BASE OF BRAIN.—From meningitis, tumours, caries of petrous bone. *In fractures usually escapes.* Generally unilateral.
4. DISTAL TO GASSERIAN GANGLION.—First division: From tumours or sepsis affecting cavernous sinus; aneurysm of internal carotid; cellulitis, etc., of orbit. Second and third divisions: growths of sphenomaxillary fossa.

Lesions of the Fifth Cranial Nerve, *continued*.**Symptoms.**—**SENSORY PORTION.**—

1. *Loss of sensation*: half of face and scalp, of anterior two-thirds of tongue (to circumvallate papillæ), of soft and hard palate and upper lip, and of nose; also conjunctival (absence of conjunctival and corneal reflexes). Epicritic slightly less than protopathic loss. (On drinking, cup feels broken.)
 2. *Tingling and pain*: may precede loss of sensation.
 3. *Secretions diminished*—buccal, nasal, and lachrymal.
 4. *Sense of smell affected*, from absence of secretion.
- Movements of face muscles awkward, owing to loss of proprioceptive sensation.

Ulceration of cornea frequent, from injury when insensitive.

Herpes zoster in area of ophthalmic branch may occur, and subsequent neuralgia.

MOTOR PORTION (in infranuclear lesions only).—

1. *Loss of power in muscles of mastication* on affected side, viz., temporal, masseter.
 2. *Inability to move jaw towards sound side*; on depression, jaw deviates to affected side (external pterygoid muscle). Mastication is possible by muscles of sound side.
- Spasm of muscles* (see FACIAL SPASM, p. 1075).

Sense of Taste: Note on Path of Impulses.—Loss of sense of taste over anterior two-thirds of tongue possibly follows paralysis of fifth nerve. The course of fibres transmitting gustatory sensations to the brain is in dispute.

1. **ANTERIOR TWO-THIRDS OF TONGUE.**—By lingual nerve, chorda tympani, and facial nerve, to geniculate ganglion. Further course, possibly: (a) Great superficial petrosal nerve to Meckel's ganglion and the second division of the fifth nerve (probable course); or (b) By the pars intermedia with the facial nerve.
2. **POSTERIOR THIRD OF TONGUE.**—Either: (a) By the glossopharyngeal nerve to the petrous ganglion, thence by Jacobson's nerve and the small superficial to the otic ganglion and the third division of the fifth nerve (hence it is possible that all taste fibres end in the fifth nucleus); or (b) Direct in the glossopharyngeal nerve.

Possibly these paths are alternatives.

TRIGEMINAL NEURALGIA

(*Tic Douloureux. Epileptiform Neuralgia. Neuralgia Major.*)

Paroxysmal pain in the course of branches of the fifth cranial nerve in the absence of recognizable lesions.

Etiology.—

AGE AT ONSET.—Middle life.

SEXES.—About equal.

EXCITING CAUSE OF ATTACKS.—Of first attack, none. Subsequently: *change of weather*, constipation, worry, debility, or none.

NO NEUROTIC FACTOR.

Morbid Anatomy.—Origin is in, or distal to, Gasserian ganglion, but histology normal, or slight fibrosis. *Pathogenesis* unknown.

General Characteristics.—

1. **DISTRIBUTION OF PAIN.**—Usually second or third branches; ophthalmic branch rare and late. Pain in course and area of nerve: may be superficial tenderness. Never commences outside area of nerve, but during attack may spread to neck, behind ear, and occipital region. *Very rarely bilateral.*
OPHTHALMIC BRANCH.—Rarely affected. Pain from supra-orbital notch over scalp.
SECOND BRANCH (*infra-orbital neuralgia*).—Pain between orbit and mouth. Tender spots at side of ala nasi, infra-orbital foramen, along gums, malar bone.
THIRD BRANCH.—Pain in lower jaw, often tongue, and later ear and temple. Tender spots at mental foramen and in front of ear.
2. **COMMENCES** "just under the skin", and radiates thence through course of nerve.
3. **COMMONEST POINTS OF ORIGIN.**—(a) Just external to ala nasi; (b) Infra-orbital foramen; (c) Mental foramen (below canine tooth).
4. **CHARACTER OF PAIN.**—Paroxysmal; in later stages agonizing, resembling 'red-hot needles'.
5. **DURING ATTACK,** repeated paroxysms occur: of duration few seconds to minutes. Often numerous, day and night. Follow trivial stimuli, e.g., eating, speaking, draughts.
6. **ATTACKS RECUR,** with remissions. Intervals diminish; intensity increases; distribution spreads.
7. **NO TENDENCY TO CESSATION OF ATTACKS.**

VARIOUS SYMPTOMS, vasomotor, trophic, often occur during paroxysm: (1) Local flushing and sweating; (2) Lachrymation, salivation, thin nasal discharge; (3) Twitching of facial muscles (face also often drawn up from pain). After repeated attacks: skin becomes shiny, hair in area may be gray or rubbed away. Mouth often foul (from fear of cleansing), and teeth removed.

Treatment.—Investigate cranial sinuses.

ANALGESIC DRUGS.—E.g., aspirin, luminal, gelsemium, butyl-chloral hydrate. For at least six months before operative measures.

SPECIAL METHODS WHEN DIAGNOSIS IS FULLY ESTABLISHED.—(1) *Schlösser's treatment*: Injection of alcohol into Gasserian ganglion or nerve trunks on emerging from the foramina. Anæsthesia results in course of branch. Freedom from pain often for many months: can be repeated. (2) *Extirpation of Gasserian ganglion*: Results extremely good, but now rarely necessary.

NEURALGIA MINOR OF THE FIFTH NERVE, AND ALLIED CONDITIONS.

A group varying from conditions resembling tic douloureux to simple 'headaches'. These must be excluded before diagnosing tic douloureux.

1. ORGANIC DISEASE AFFECTING FIFTH NERVE (see p. 997).—Symptoms may resemble tic douloureux.
2. NEURALGIA MINOR.—
 - a. Pain shooting along nerve: superficial tenderness, slight and only in distribution of nerve. From teeth, errors of refraction, iritis, etc.
 - b. *Referred pain*, characterized by *pain and superficial tenderness* in areas not corresponding to peripheral nerves. Due to teeth and other local causes.
 - c. Secondary to disease elsewhere in body.
 - d. In general debility, anæmia, neurasthenia, etc.

V. SEVENTH OR FACIAL NERVE.

Anatomy.—*Nucleus* in pons, in floor of fourth ventricle. The fibres wind round nucleus of sixth nerve, then lie close to fibres from the cerebral cortex on their way to the decussation in the medulla, and emerge between pons and cerebellum. The seventh and eighth nerves pass to the internal auditory meatus; the seventh enters the aqueduct of Fallopius, and, after its intrapetrous course, emerges at the stylomastoid foramen.

Paralysis of the Facial Nerve.—The facial nerve may be affected at numerous sites; lesions of other structures aid in localization.

1. SUPRANUCLEAR LESIONS.—In cortex, corona radiata, internal capsule, or rarely upper portion of pons. *Causes*: Tumours, abscess, hæmorrhage, or thrombosis. *Special characters*: (i) Upper branch unaffected—viz., frontalis, orbicularis palpebrarum, corrugator (bilateral supply); (ii) Hemiplegia usually present; (iii) Paralysis of upper motor neuron type. If 'conjugate deviation' present, looks towards the side of the lesion (except in early spasm—see p. 994). Voluntary movements affected more than emotional.
2. NUCLEAR LESIONS.—Generally as part of bulbar paralysis, and sixth and other nuclei are affected: upper fibres generally escape, otherwise of lower motor neuron type. Rarely in diphtheria, encephalitis, lesions of pons.
3. INFRANUCLEAR LESIONS.—Entire peripheral nerve affected; lower motor neuron type. (Always consider syphilis.)
 - a. IN PONS.—*Special characters*: (i) 'Crossed paralysis' common—face on side of lesion, arm and leg on opposite side; (ii) Nucleus of sixth nerve almost always affected—'conjugate deviation' away from lesion. Often fifth nerve also involved.
 - b. AT BASE OF BRAIN.—*Causes*: Cerebello-pontine tumours, gumma, meningitis, occasionally fractures. *Special characters*: Eighth nerve usually affected (note that deafness with facial paralysis also occurs from otitis media).

c. **WITHIN TEMPORAL BONE.**—*Causes*: Especially caries in otitis media, occasionally operations on mastoid. *Special characters*: Taste lost in anterior two-thirds of tongue, unless lesion below separation of chorda tympani (rare); if stapedius affected, hypersensitiveness to musical tones.

d. **PERIPHERAL NERVE (Bell's palsy).**—Common. *Causes*:—

i. Injuries and blows close to foramen, operations on tumours, forceps at birth.

ii. 'Cold' or 'rheumatic' form; commonest variety; constitutes true 'Bell's palsy'. Is a parenchymatous neuritis, probably swelling and compression of nerve within Fallopian aqueduct.

iii. Syphilis: not uncommon cause.

Tetanus is occasional cause; *mumps* never.

Facial diplegia rare. From double otitis media, lesions of pons or base of brain, rarely diphtheria.

Symptoms of Paralysis of Peripheral Nerve, or 'Bell's Palsy'.

—(Characteristics of lesions at special sites are referred to above; note especially supranuclear lesions.)

ONSET.—In 'rheumatic' form, sudden; maximum paralysis within twenty-four hours. In otitis media, onset more gradual.

Loss of power on affected side; both voluntary and emotional movements. *Skin* smooth, may be slight swelling. *Pain* near ear occasionally. *Paralysis* of lower motor neuron type.

CHARACTERISTICS.—

1. **EYE CANNOT BE CLOSED** (orbicularis palpebrarum). In attempting closure, eyeball turns up and outwards (inferior oblique).
2. **FOREHEAD CANNOT BE WRINKLED** (frontalis). **FROWNING LOST** (corrugator).
3. **IN 'SHOWING THE TEETH'**, lips not separated on affected side.
4. **IN SMILING**, affected side unresponsive.
5. **WHISTLING** impossible.
6. **ON PROTRUDING TONGUE**, lips drawn to sound side, hence tongue appears to be towards paralysed side, but is median to teeth.

OTHER FEATURES—Food collects in cheek (buccinator). Fluid runs out while drinking. Nostril falls in during inspiration. Conjunctiva liable to injury, lower lid droops, epiphora common. Speech slightly affected. Reflexes absent. If stapedius paralysed, oversensitiveness to musical tones

SENSATION UNAFFECTED, except in small area near and including external auditory meatus.

(*Note.*—This area of anaesthesia proves that the seventh is a mixed nerve, but exact sensory functions still in dispute.)

TASTE lost in anterior two-thirds of tongue, if chorda tympani involved. (For *paths of taste*, see **FIFTH NERVE**, p. 998.)

IN OLD-STANDING CASES.—Wrinkles more marked on affected side from muscular contractures, and until tests are performed the sound side appears to be paralysed. Reaction of degeneration present.

Seventh or Facial Nerve—Lesions, *continued*.

Course and Prognosis.—When due to 'cold', recovery usual and may be complete. From injury, paralysis more often permanent. With other factors, varies with cause.

ELECTRICAL REACTIONS.—(1) If no change within two weeks, recovery usual in three to four weeks; (2) If reaction of degeneration present after three months, recovery rarely complete. Various intermediate changes and prognoses.

RECOVERY may commence up to three months after lesion, and, once commenced, improvement may continue for twelve to eighteen months.

Treatment (of Bell's palsy from 'cold').—

AT ONSET.—Hot fomentations over ear, or small blister over *mastoid*. Free purge. Sodium salicylate and potassium iodide.

AFTER ONE TO TWO WEEKS, commence: (1) *Galvanic current*, quarter-hour, daily; positive pole behind ear, negative pole stroked over muscles. (2) Massage.

CAUSAL CONDITIONS must be treated. If syphilis, usual methods. If nerve divided at operation, ends to be united if possible: immediately, if discovered at time; otherwise may wait until wound healed. Otitis media: indicates complete mastoid operation.

NERVE ANASTOMOSIS.—Indications justifying this operation are: (1) Improvement not commencing six months after lesion, (2) Severity of affection. Anastomosis preferably with hypoglossal nerve; at first tongue contracts with face, but dissociated movements become established. Spinal accessory nerve less advisable; causes twitching of shoulder.

Spasm of Facial Muscles.—See FACIAL SPASM, p. 1075.

VI. EIGHTH OR AUDITORY NERVE.

The auditory nerve consists of two separate parts: (1) The *cochlear* nerve, concerned in hearing; (2) The *vestibular* nerve, concerned with equilibrium.

1. COCHLEAR NERVE.

Anatomy.—From the organ of Corti in the labyrinth and the spiral ganglion, fibres run to the two nuclei of the cochlear nerve in the floor of the 4th ventricle; whence: (1) From the tuberculum acusticum, fibres pass anterior to the restiform body in the striae acusticae, and after decussation reach the lateral fillet; (2) From the ventral nucleus, fibres pass posterior to the restiform body, through the superior olive to the lateral fillet. From the latter, paths lead to the posterior corpus quadrigeminum and to the median geniculate body, and thence through the internal capsule to the cerebral cortex (temporal gyrus). Through the superior olive are communications with the third, fourth, and sixth nuclei, connecting hearing with eye movements.

Site of Lesions.—

LESIONS OF CENTRE IN CORTEX, superior temporal gyrus, produce, not deafness, but (if on left) word-deafness—viz., meaning of words not understood.

LESIONS OF NERVE AT BASE OF BRAIN arise from: tumours, especially cerebello-pontine; fractures; hæmorrhage; meningitis; syphilis. Also tabes, tobacco, quinine.

Symptoms Resulting from Lesions.—(1) Hyperæsthesia or altered function; (2) Deafness or diminished function.

1. **HYPERÆSTHESIA OR HYPERACUSIS.**—Sounds heard with unusual intensity. Rare. In hysteria, and rarely in cerebral lesions. With paralysis of stapedius (seventh nerve), low musical tones are very intense.

DYSACUSIS.—Intolerance of sounds; occurs in headache, neurasthenia, and in some cerebral lesions.

TINNITUS AURIUM.—Subjective sensations of ringing, etc., in the ear.

Causes include: (a) Wax on drum; (b) Anæmia; (c) Neurasthenia; (d) Certain drugs, e.g., quinine, salicylates; (e) Middle-ear disorders; (f) Epileptic aura (rare); (g) Exposure to loud noises; and (h) Labyrinthine disturbances, as in Ménière's disease. Possibly also gout, migraine.

Varieties.—May be: (a) Continuous; (b) Pulsating tinnitus (rarely due to aneurysm); less commonly (c) 'Clicking', probably clonic spasm of tensor tympani.

Treatment.—Examine ear for local causes. Treat any general factors. Tonics or potassium bromide to be tried.

2. **DEAFNESS OR DIMINISHED FUNCTION.**—*Causes:* (a) Outer ear—wax on drum; (b) Middle-ear conditions; (c) Internal ear, affecting labyrinth. The last may be primary, or secondary from middle ear, and includes: (i) Inflammations; (ii) Scleroses from syphilis, mumps, and rarely other infectious diseases; (iii) Cerebrospinal meningitis, tumours and fractures affecting nerve; (iv) Gout, diabetes, nephritis; (v) Hæmorrhage and effusions; (vi) From quinine and salicylates, transient.

TUNING-FORK TESTS FOR NERVE DEAFNESS.—

1. *Weber's Test.*—Place on forehead; loudest on deaf side if conducting apparatus affected, but loudest on sound side if nerve affected.
2. *Rinne's Test.*—Tuning-fork vibrating placed on mastoid; when no longer audible is held to external auditory meatus; if audible, proves 'nerve-deafness' ('positive Rinne test').

In 'nerve-deafness', hearing better in quiet place. In deafness from middle-ear disease, hearing better amid noise.

2. VESTIBULAR NERVE.

Anatomy.—From the lining membrane of the semicircular canals, filaments run to the ganglion vestibulare, and thence to the brain. Here they enter: (1) *Deiters' nucleus* (lateral eighth nucleus); thence fibres run in the middle peduncle to the 'roof nuclei' of the cerebellum, here connecting with motor tracts to the muscles. (2) *Median nucleus*; the fibres from here decussate; some (a) enter posterior longitudinal bundles connecting with third, fourth, sixth nuclei; others (b) enter tegmentum and pass through internal capsule to cerebral cortex. (3) The nucleus of the descending root; to vestibulo-spinal tract. The vestibular nerve is thus connected with important structures controlling equilibrium; it also receives fibres from the labyrinth.

Symptoms Resulting from Lesions.—(1) Vertigo. (2) Nystagmus. Tinnitus and deafness are not uncommonly present (cochlear nerve).

Bárány's Tests for Vestibular Lesions.—

1. **CALORIC TEST.**—Irrigate external auditory meatus. Normally, causes nystagmus or lateral deviation: (a) with cold water, towards opposite side; (b) with hot water, toward tested side. No response if paralytic labyrinthine lesion.
2. **POINTING TEST.**—Patient touches a spot straight in front with finger, and attempts to repeat with eyes shut. In labyrinthine paralysis, finger 'points past' to side of lesion. In labyrinthine irritation, points away from lesion.

Vertigo.

Among numerous causes are: (1) Rapid changes of position, especially rotary; (2) Disturbances of alimentary canal, heart, kidney, circulation, etc., including high and low blood-pressure; (3) Ocular defects; (4) Alcohol, tobacco in excess, and other drugs; (5) Diseases of the brain, markedly in cerebellar lesions; (6) Epilepsy; (7) Migraine; (8) Numerous ear conditions (many of the previous causes are also directly due to action on labyrinthine pressure)—e.g., wax, otitis media, labyrinthitis; (9) Encephalitis; (10) Allergy.

Auditory Vertigo.—Vertigo results from any condition affecting the pressure of the endolymph in semicircular canals, and thus disturbing the mechanism of equilibrium, or causing irritation of vestibular nerve. Causes resemble those of deafness (q.v.).

Labyrinthitis.

Actual disease of the labyrinth occurs in two forms: (1) True *Ménière's disease*, acute primary labyrinthitis; (2) *Ménière's symptom-complex*, labyrinthitis chronic and secondary, e.g., to middle-ear disease.

1. MÉNIÈRE'S DISEASE.—Acute labyrinthitis.

CAUSE.—Hæmorrhages, effusions, or acute inflammation of labyrinth.

AGE.—Past middle age.

ONSET.—Sudden.

SYMPTOMS.—(a) *Vertigo*: patient falls to ground; may be transient unconsciousness. (b) *Tinnitus*: onset may precede vertigo. (c) *Nausea*, pallor, cold sweat, and vomiting follow; may be collapse. (d) *Deafness* then noted. Nystagmoid movements may occur, away from affected side. Paroxysms recur at irregular intervals. *Deafness progressive*. Tinnitus may persist, and *psychical changes* develop.

2. MÉNIÈRE'S SYMPTOM-COMPLEX.—

CHARACTERISTICS.—(a) *Tinnitus*; (b) *Attacks of vertigo*; with (c) *Nausea*; (d) *Progressive deafness*.

DIAGNOSIS OF MÉNIÈRE'S SYNDROME.—From: (a) *Epilepsy*: by tinnitus and progressive deafness and absence of micturition or biting of tongue. (b) Gastric, ocular, or cardiac vertigo: rarely so severe; no progressive deafness (may be vomiting). (c) Intracranial tumours, especially cerebellar: difficult. Bárány's tests of great assistance.

TREATMENT.—Bromides or iodides of most effect. Amyl nitrite in high blood-pressure. *Low salt diet*: with ammonium chloride. *Surgical*: division of eighth nerve as final resort.

VII. NINTH OR GLOSSOPHARYNGEAL NERVE.

Probably a portion of the vagus Distribution: (1) *Motor*: Stylopharyngeus and middle constrictor of pharynx. (2) *Sensory*: Upper pharynx. (3) *Taste* (see FIFTH NERVE, p. 998). Little known of isolated lesions.

VIII. TENTH, VAGUS, OR PNEUMOGASTRIC NERVE.

Anatomy.—Nerve leaves brain in medulla between olivary and restiform bodies

MOTOR FIBRES—Arise from nucleus ambiguus in medulla. Supply voluntary muscles of soft palate (except tensor palati); pharynx and larynx; unstriped muscle of respiratory and alimentary tracts.

SENSORY FIBRES.—Arise from ganglion of root in jugular foramen and of trunk outside skull; connect with tractus solitarius and dorsal nucleus in medulla. Supply respiratory tract, pharynx, œsophagus, lungs, heart, and abdominal viscera.

Site and Cause of Lesions.—

1. **NUCLEUS.**—Bulbar paralysis, tabes (crises), encephalitis. Rarely syringomyelia, disseminated sclerosis, rabies.
2. **AT BASE OF BRAIN.**—Tumours, meningitis (especially syphilitic), aneurysm.
3. **IN NECK.**—Operations, wounds, tumours.
4. **IN THORAX.**—Especially in thoracic aneurysm; usually left recurrent laryngeal nerve; on right rarely in pleural adhesions.
5. **NEURITIS.**—Diphtheria; rarely in alcohol, influenza, arsenic.

Lesions of the Vagus Nerve, *continued*.

Total Unilateral Paralysis.—Principal results: (1) *Paralysis of palate*; shown on movement only; may be partial anæsthesia of palate and pharynx. (2) *Paralysis of pharyngeal muscles*; symptoms slight. (3) *Vocal cords* in 'cadaveric position'; voice nasal or hoarse, cough weak and harsh.

Pharyngeal Branches.—

BILATERAL PARALYSIS, usually from bulbar paralysis or diphtheria. Difficulty in swallowing; food may enter larynx or nares (if palate paralysed).

SPASM OF PHARYNX.—In hydrophobia. Functional in hysteria and pseudo-hydrophobia.

Laryngeal Branches (*see also* THORACIC ANEURYSM, p. 848).—

PARALYSIS usually partial: abductors affected before adductors. Larynx must be examined when involvement possible, as symptoms are absent in early stages.

1. BILATERAL ABDUCTOR PARALYSIS (posterior crico-arytenoid muscles).—

Cause.—(a) Lesions in nuclei—bulbar paralysis, tabes.

(b) Pressure on both vagi or recurrent laryngeals. Rarely in laryngeal catarrh, hysteria.

Symptoms.—(a) *Inspiratory stridor*, expiration normal. (b) *Voice unaffected*, coughing normal; (c) *Dyspnœa*—often dangerous, tracheotomy may be necessary.

On Examination of Larynx.—Vocal cords almost in position of phonation, no movement on inspiration. Adductors involved later.

2. UNILATERAL ABDUCTOR PARALYSIS.—

Cause.—Aneurysm. Rarely mitral stenosis, tumours.

Symptoms.—Voice generally hoarse or altered; no dyspnœa.

On Examination.—Vocal cord on affected side shows no movement on inspiration.

3. ADDUCTOR PARALYSIS (lateral crico-arytenoid and arytenoid muscles).—

Cause.—Hysteria.

Symptoms.—Aphonia, no stridor or dyspnœa.

On Examination.—Cords do not approximate on phonation.

SPASM OF MUSCLES OF LARYNX.—In children, adductor spasm occurs in laryngismus stridulus. In adults, in rare laryngeal crises of tabes, and rarely in hysteria.

ANÆSTHESIA OF LARYNX.—In bulbar paralysis, diphtheria. Food may enter larynx.

Lesions of Branches to the Heart and Viscera.—Do not produce characteristic symptoms.

CARDIAC BRANCHES.—Vagus is cardio-inhibitory. Irritation slows the heart rhythm, paralysis accelerates it.

IX. ELEVENTH OR SPINAL ACCESSORY NERVE.

Anatomy.—Consists of two portions: (1) *Accessory portion*: Nuclei in medulla, continuous with vagal nuclei. Rejoins vagus and supplies muscles of larynx and pharynx. (2) *Spinal portion*: From anterior horns of first to fifth cervical segments. Fibres pass up through foramen magnum. Supplies sternomastoid and trapezius muscles. Nerve leaves skull through jugular foramen.

Site and Cause of Lesions.—

NUCLEI.—In bulbar paralysis. Spinal portion in progressive muscular atrophy. Occasionally in syringomyelia.

AT BASE OF BRAIN.—Caries of vertebræ, tumours, meningitis.

PERIPHERAL NERVE.—Wounds, cervical caries, etc.

Paralysis of Sternomastoid (unilateral).—Rotation of head to other side impaired. No deformity. Muscle wastes.

Paralysis of Trapezius.—Upper portion suffers most: deficient movement of scapula on deep breath or shrugging shoulder. If middle portion weakened: shoulder drops, power of lifting arm impaired. Paralysis of lower portion resembles serratus magnus paralysis: angle of scapula rotated inwards by rhomboids and levator anguli scapulæ. (Trapezius is also supplied by third and fourth cervical nerves.)

Unilateral Paralysis.—If trapezii affected, head falls forward, as in progressive muscular atrophy. If sternomastoids affected, head falls back.

Spasm of Sternomastoid and Trapezius (Torticollis).—See SPASMODIC TORTICOLLIS, p. 1077.

X. TWELFTH OR HYPOGLOSSAL NERVE.

Motor nerve of the tongue. Nucleus in medulla, in floor of fourth ventricle.

Site and Cause of Lesions.—

1. **SUPRANUCLEAR AND CORTICAL.**—Common in *hemiplegia*.
2. **NUCLEAR.**—*Bulbar paralysis*, tabes; rarely in syringomyelia, disseminated sclerosis. Usually bilateral.
3. **INFRANUCLEAR.**—Usually unilateral. Syphilis, tumours, meningitis, fractures, and injury from operations in neck.

Symptoms.—

1. **UNILATERAL NUCLEAR OR INFRANUCLEAR PARALYSIS.**—(a) *Paralysis of tongue*: On protrusion, drawn by sound geniohyoglossus towards affected side. (b) *Atrophy of tongue*: Unilateral. May be reaction of degeneration. (c) *Mucous membrane of tongue in folds*.
2. **NUCLEAR LESIONS.**—Usually bilateral: tongue immobile, speech and mastication difficult. Orbicularis oris, supplied by fibres from twelfth running in seventh nerve, usually paralysed in nuclear lesions.

Lesions of the Hypoglossal Nerve—Symptoms, *continued*.

3. SUPRANUCLEAR LESIONS.—Wasting slight. Also hemiplegia.
4. LESIONS IN MEDULLA.—Pyramidal tract usually involved, whence 'crossed paralysis', viz., limbs on one side, and tongue on other; on protrusion, tongue deviates towards *sound* limb.

CHAPTER CLXX.

DISEASES OF THE CEREBRUM.

I. APHASIA.

Disorders of speech result from *lesions of special speech centres* in the cerebral cortex and of association fibres deep to those centres, and also from lesions of the *motor cortical centres* and path connecting them with the muscles of articulation.

Note on Theories of Aphasia.—Speech is necessarily dependent on many factors, anatomical, physiological, and intellectual. Numerous theories have been evolved from different aspects and have produced prolonged controversies. The views followed are those of the 'diagrammatists'. Over many years they have answered the purposes and tests of the clinician by diagnosing correctly the site of a lesion. But many cases fail to 'fit in' with the hard-and-fast centres, and the theory is manifestly imperfect, taking no note of well-known factors of intellect and emotion. Marie, in 1905, denied the existence of all centres, including Broca's area, and considered aphasia to be invariably an impairment of intellect due to lesions of a region specialized for language in general, the 'zone of Wernicke' in the angular and supramarginal gyrus and posterior ends of the first and second temporal convolutions. Head more recently has studied aphasia from the aspect of disturbance of intellect, and regards it as an interference with expression of thought, speech being regarded as an entity, and indivisible into the watertight compartments of motor, sensory, and other diagrammatic aphasias. As there is obviously truth in all these opposing views, no satisfactory explanation of aphasia can be expected until they have been fitted together.

Speech Centres.—Four special centres (arranged in the order of development in a child, and in sites for right-handed subjects):—

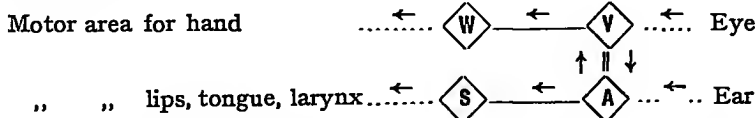
1. AUDITORY SPEECH CENTRE (A).—In first left temporal convolution. Centre for memory of sounds of words, i.e., ability to understand meaning of words heard.
2. MOTOR SPEECH CENTRE, OR GLOSSO-KINÆSTHETIC CENTRE (S).—In 'Broca's area', third left frontal convolution, and thus close to motor cortical centres for lips and tongue. Centre for production of speech.

3. **VISUAL SPEECH CENTRE (V).**—In angular and supramarginal gyri. Centre for meaning of written words, i.e., reading.
4. **WRITING CENTRE, OR CHEIRO-KINÆSTHETIC CENTRE (W).**—In second left frontal convolution, and thus close to motor cortical centre for hand.

(The centres may be briefly referred to by the letters placed against them.)

These centres fall into two groups: (i) *Motor speech centres*, S and W, concerned in performance of speech, spoken or written; (ii) *Sensory speech centres*, A and V, concerned in the reception and memory of speech. The former are close to the motor area, and hemiplegia is common in their lesions. The latter are close to the optic radiations, and sight may be affected.

The centres and their usual connecting tracts may be represented thus:—



'AUDITIVES' AND 'VISUALS'.—In most persons the memory of words depends mainly on auditory afferent impulses and is stored in the auditory speech centre. In the rarer 'visual', the memory depends mainly on visual afferent impulses and is stored in the visual speech centre.

Types of Aphasia.—Depending on site of lesion, aphasia may be:

1. **MOTOR APHASIA.**—Lesions of speech and writing centres.
2. **SENSORY APHASIA.**—Lesions of auditory and visual centres: word-deafness and word-blindness.
3. **ANARTHRIA, APHEMIA, ETC.**—Lesions of the motor tract to the muscles concerned in articulation.

1. MOTOR APHASIA.

Characterized by *loss of voluntary speech*. Lesion in Broca's area.

Complete Motor Aphasia.—

VOLUNTARY SPEECH.—Lost.

UNDERSTANDING OF SPEECH.—Retained, but some deficiency invariable.

AGRAPHIA.—Usually present: from proximity of writing centre (W).

'**RECURRING UTTERANCES**'.—Though speechless, is not wordless (Hughlings Jackson); may repeat a few inappropriate sentences; ascribed to centre in opposite hemisphere.

ALEXIA (loss of reading).—Usual in some degree.

All degrees occur to slight deficiencies, patient making mistakes in speech and recognizing the errors.

Agraphia.—Inability to write occurs in all grades of severity. Theoretically from lesion of cheiro-kinæsthetic area, but lesion

Motor Aphasia—Agraphia, *continued*.

rarely (if ever) localized, and *paralysis of hand* also exists from lesion of motor cortex. May be able to write from dictation.

Hemiplegia.—Usually present in motor aphasia, lesion including Rolandic area.

2. SENSORY APHASIA.

Defects in spoken or written speech due to lesions of the auditory and visual centres—causing defects in auditory or visual word-memory—or to lesions which destroy the afferent paths of auditory or visual speech stimuli. Lesions, then, may be: (1) In the centres (A or V); (2) Subcortical, involving the afferent paths to these centres, and the paths connecting the two hemispheres. The common defects are *word-deafness* and *word-blindness*.

Word-deafness or Auditory Aphasia.—Lesion of auditory speech centre may be complete or partial.

COMPLETE LESION OF CENTRE.—Disturbance of all forms of speech.

SYMPTOMS.—

1. Complete word-deafness: sounds convey no meaning.
2. Speech is a mere jargon of words. Reading and writing also lost.
3. Intellect disturbed.

In rare marked 'visuals', some voluntary speech may be performed by a direct path $V \rightarrow S$, the visual centre retaining the speech memories, and reading and writing may be to some extent retained. The prognosis in 'visuals' is thus better than in 'auditives'.

PARTIAL LESIONS OF CENTRE.—More frequent. All grades of severity occur, e.g. :—

1. Auditory word-memories can be revived by stimuli arriving at centre; thus patient *understands speech* and can read, while *voluntary speech is very slight*.
2. *Paraphasia*. In slighter degrees, voluntary speech present, but uses wrong words and is unaware of error. Understands, reads, and writes at dictation.

Amnesia verbalis (Bastian) is forgetfulness of words. An object may be described, e.g., 'something to write with' for 'pen'.

PURE WORD-DEAFNESS OR AUDITORY APHASIA.—A *subcortical lesion* may leave centre intact but isolated from afferent impulses. Extremely rare.

SYMPTOMS.—

1. Centre and efferent paths intact. Therefore: (i) Talks correctly (A intact); (ii) Reads aloud and can understand writing ($V \rightarrow A \rightarrow S$ intact).
2. Afferent paths interrupted. Therefore: (i) Does not understand speech; (ii) Cannot repeat words or write from dictation.

Word-blindness or Visual Aphasia.—Lesion in angular gyrus. May affect centre or subcortical paths.

LESION OF VISUAL CENTRE.—

SYMPTOMS.—

1. Unable to read ; may recognize familiar portraits.
2. Understands speech.
3. Voluntary speech little affected.
4. Agraphia present, and unable to copy. Writing sometimes present in educated strong 'auditives', by direct A→W path, usually with 'paragraphia', i.e., writes wrong words ; cannot read what he has written.

PURE WORD-BLINDNESS OR VISUAL APHASIA.—A *subcortical lesion* may leave centre intact but isolated from afferent impulses. Very rare.

SYMPTOMS.—

1. Centre and efferent paths intact. Therefore : (i) Understands speech ; (ii) Voluntary speech normal ; (iii) Writes, *but is unable to read* what is written.
2. Afferent paths interrupted. Therefore unable to read.
3. Right homonymous hemianopia (or rarely hemichromatopia) present from injury to optic radiations.

Word-deafness and Word-blindness.—May be combined in lesions affecting both centres. If complete, unable to understand, read, write, or speak. More commonly partial, with some degree of voluntary speech and communication by signs.

3. ANARTHRIA.

Disorders of articulation resulting from lesions of paths conducting impulses from motor centres to muscles of tongue, lips, and larynx. Lesions may occur at various sites :—

1. Supranuclear Lesions.—

BILATERAL LESIONS OF INTERNAL CAPSULE.—'*Pseudo-bulbar paralysis*'. Associated with double hemiplegia. The two lesions are usually not simultaneous. Affection of articulation permanent and may be complete.

BILATERAL LESIONS OF MOTOR CORTEX.—Less commonly.

SINGLE LESION OF MID-BRAIN AFFECTING BOTH TRACTS.—Rarely.

All these are lesions of upper motor neuron type : tongue firm and not wasted.

Transient and incomplete forms occur in unilateral lesions.

2. Lesions of Nuclei and Lower Motor Neuron.—Especially *bulbar paralysis*. Tongue wasted.

Disturbances of Co-ordination or ataxia of muscles of articulation may occur, e.g., in disseminated sclerosis, Friedreich's ataxia.

INVESTIGATION OF APHASIA.

Note.—In hemiplegia, hemianopia, etc., ascertain if patient is right-handed.

Series of Questions to Ascertain Lesion (based on plan of Beevor).—

1. Can he speak voluntarily and intelligently ? (S). Motor aphasia.
2. Can he understand what is said ? (A). Word-deafness.

Investigation of Aphasia, *continued*.

3. Can he understand writing? (V). Word-blindness.
4. Can he write spontaneously? (W). Test for agraphia often difficult owing to paralysis of hand.
5. Can he repeat words? (A \rightarrow S).
6. Can he copy from print? (V \rightarrow W).
7. Can he pick out objects named? (A \rightarrow V).
8. Can he write from dictation? (A \rightarrow V \rightarrow W).
9. Can he name objects seen, and read aloud? (V \rightarrow A \rightarrow S).

PROGNOSIS AND TREATMENT OF APHASIA

Depends on age of patient and severity of lesion. In the young, recovery may occur, possibly from development of opposite hemisphere. Re-education needs patience. In adults, improvement less common.

II. APRAXIA. AGNOSIA.

A disorder of cerebral functions characterized by inability to perform certain familiar purposive movements, but with absence of motor or sensory paralysis and any general defect of intelligence. The deficiency may be of motor or sensory origin, constituting respectively apraxia and agnosia.

Apraxia.—Inability to perform a movement corresponding to a correct mental idea, i.e., subject knows what he wants to do, but is unable to do it. Thus motor aphasia is verbal apraxia.

Example.—When given a match, recognizes it as such but unable to strike it. May be bilateral or unilateral (movements correctly performed by one hand). Skilled and complex movements most affected.

PATHOLOGY.—Lesions of the three frontal convolutions; the third (Broca's area) produces motor aphasia, i.e., verbal apraxia. The first and second are probably similar centres for co-ordinating limb movements. Also lesions of anterior portion of corpus callosum (connecting the hemispheres).

Note.—A lesion on the left (in right-handed subjects) may interrupt fibres to the right hemisphere and produce *unilateral left-handed apraxia*.

Agnosia.—Inability to understand meaning of a sensory stimulus. Varieties correspond to various forms of stimuli. Thus sensory aphasia is verbal agnosia; word-deafness is auditory agnosia, latter also including failure to recognize meaning of any sounds; astereognosis is tactile agnosia. Apraxia is necessarily present in agnosia.

Example.—When given a match, does not recognize it as such, may call it a pen.

PATHOLOGY.—Lesions of posterior portion of the external surface of the hemispheres, especially the occipital cortex. Complicated by other deficiencies. Occurs also in diffuse lesions, especially dementia paralytica.

III. INTRACRANIAL TUMOURS.

Pathology.—(1) Infective granulomata; (2) Tumours; (3) Cysts.

1. INFECTIVE GRANULOMATA.—

TUBERCLE.—Commonest tumour in childhood, uncommon over 20 years. *Special sites*: Cerebellum, pons. *Size*: Up to golf ball, often multiple; on section cheesy; may be softening. Tuberculosis of bones and glands common; may be terminal tuberculous meningitis.

SYPHILOMA, GUMMA.—Common in adults, rarely in congenital syphilis. *Special sites*: Cortex, pons; is rare in cerebellum. *Origin*: Superficial, from meninges, or arteries. Rarely large, may be multiple; may shrink and become encapsuled. Some gummatous meningitis common at base.

2. TUMOURS.—

GLIOMA.—Commonest tumour in adults; often chronic. *Special sites*: Cerebral cortex, also cerebellum, pons, etc. Consistency varies from firm to soft and vascular, with frequent hæmorrhage. Appearance resembles brain tissue, and tends to infiltrate and not displace substance, hence margin indefinite, and capsule rare. May be a diffuse gliosis in tissues outside the definite tumour.

Histology.—*Origin* usually from neuroglia, occasionally from ependyma. *Cells*: Vary in different tumours from embryonic cells to neuroglial spider cells and to ganglion cells.

ENDOTHELIOMA.—*Special sites*: Cerebellopontine angle, also sagittal sinus. Very chronic; encapsuled; produce pressure effects. Most operable of tumours

NEUROMA.—On cranial nerves, especially nervus acusticus. (Von Recklinghausen's neurofibromatosis may also be intracranial.)

SARCOMA OF BRAIN SUBSTANCE.—Rapid growth. Not common.

CARCINOMA.—Primary rare; secondary not uncommon, especially to breast. Growth rapid. *Special sites*: Cortex, cerebellum, occasionally the choroid plexus.

Other varieties include:—*Fibroma*: from meninges. *Osteoma*: from falx cerebri, or growing inwards from cranium. *Psammoma* ('brain-sand'): pineal gland or choroid plexus. *Cholesteatoma*: has glistening appearance, never from brain substance, usually from middle ear in chronic suppuration, and perforates bone. *Lipoma*: from corpus callosum. *Teratoma*: usually pituitary gland. Also *intracranial aneurysms* (see p. 1036).

3. **CYSTS.**—Include: *Porencephaly*: cysts between brain and meninges, from hæmorrhage or maldevelopment dating from birth. *Degenerated tumours*: especially in cerebellum. *Hydatid cysts*. *Cysticercus cellulosæ*, often multiple; produce varied symptoms (see *CYSTICERCUS*, p. 202).

Etiology.—

SEX.—Males twice as common as females, not accounted for by syphilis.

AGE.—Tubercle, under 20 years. Glioma, 20 to 45 years. Cancer, 40 to 60 years.

Intracranial Tumours, *continued*.

Symptoms.—Very variable. Two main groups: (A) *General symptoms*: from increased intracranial pressure. (B) *Localizing symptoms*: from irritation and destruction of tissue.

In localization, difficulties may arise from: (1) 'Silent areas' (2) Increased intracranial pressure affecting nerves distant from tumour; (3) Spreading oedema, meningitis; (4) Distant areas of softening, from tumour compressing vessels.

A. GENERAL SYMPTOMS.—Especially *headache, vomiting, and optic neuritis*.

HEADACHE.—Usually severe and constant, with greater paroxysms. Situation may correspond to tumour, but is not definitely localizing.

VOMITING.—Often early, and persistent; especially in cerebellar and pontine tumours. No nausea, abdominal pain, or relation to food.

OPTIC NEURITIS ('choked disc', *papillitis*).—Must be looked for, as vision is often normal until *atrophy* follows later. In tubercle least, in glioma most frequently. *Absence does not negative tumour*: present in about 80 per cent of all tumours. (See p. 987.)

VERTIGO.—Common; especially with cerebellar tumours.

MENTAL CHANGES.—Not uncommon in some degree, especially with tumours of frontal lobes: unusual actions, stupor, mental dullness; or psychical changes, becoming emotional or hysterical. Mania rare.

CONVULSIONS.—In tumours affecting cortex; rarely elsewhere. May be generalized, Jacksonian, or as in true epilepsy.

SLOW PULSE.

General nutrition only affected late. Polyuria, glycosuria, albuminuria occasionally.

B. LOCALIZING SYMPTOMS.—(See also respective CRANIAL NERVES, when these are referred to.)

PREFRONTAL REGION.—Usually mental dullness and apathy, or emotional changes; may be finally delusions, or dementia. Exophthalmos may develop. Grainger Stewart adds two symptoms: (a) Fine tremor of limbs on same side; (b) Superficial abdominal reflexes diminished on opposite side. *Extension* occurs into motor or speech area.

MOTOR AREA.—*Ascending frontal convolution*. Irritation at first causes spasm of muscles; destruction of tissue follows, and causes paralysis. (1) *Spasm or convulsions* (*Jacksonian epilepsy*). Commences in group of muscles of area irritated, and spreads to others. Note: (a) 'Signal symptom', i.e., site of commencement, often with tingling; (b) March of spasm; (c) Subsequent (transient) paresis. (2) *Paralysis*. Commences as monoplegia, e.g., leg, and is permanent and progressive.

Exact localization depends on arrangement of the centres, e.g., face in lower third, upper limb in middle third, lower limb in upper third. On left side also speech centre in Broca's area, 3rd frontal convolution.

Subcortical lesions.—Paralysis occurs first, spasms later as tumour reaches cortex. Sensory symptoms not uncommon, from proximity of tracts.

PARIETAL REGION.—*Ascending parietal convolution.* Impairment of sensation on opposite side of body; especially *light touch*, also of stereognosis.

Extension of tumour may involve: (1) Motor area: Jacksonian epilepsy commencing with local tingling. (2) Supramarginal and angular gyri; word-blindness and mind-blindness (on left). (3) Temporal lobe: word-deafness.

(In the ascending parietal region, sensation is probably represented in local areas opposite to, and connected with, the corresponding motor areas.)

TEMPORAL LOBE.—Mostly consists of 'silent areas' producing no localizing symptoms.

First temporal convolution.—Word-deafness (on left). With destruction, incomplete deafness of *opposite ear*; may be various auditory sensations.

Extension may involve the motor area.

Uncinate gyrus.—Disagreeable subjective sensations of taste and smell. '*Uncinate fits*': (a) Attacks of perversions of taste and smell; (b) Jackson's 'dreamy state' of unreality, or of previous identical occurrence of present surroundings.

OCCIPITAL LOBE.—May be latent. *Disturbances of vision* common: (1) Limitation of fields of vision, (i) for colours (usually earliest change), (ii) sight, e.g., homonymous hemianopia: when *cuneus* affected, quadrantic hemianopia occurs (*see also* OPTIC NERVE). Until examination, changes often unsuspected, owing to normal central vision. (2) Visual hallucinations, e.g., coloured scotoma; not common.

Extension may involve: (1) Internal capsule: hemiplegia, hemianæsthesia, hemianopia. (2) Angular gyrus: word-blindness. (3) Cerebellum: ataxia on same side.

INTERNAL CAPSULE.—The closeness of the tracts in the genu and posterior limb results in widespread paralysis. *Order of tracts* (from before backwards): (1) *Genu*: eye, head, tongue, mouth. (2) *Posterior portion, anterior two-thirds*: shoulder, elbow, wrist, fingers, thumb, trunk, hip, knee, ankle, toes. (3) *Posterior portion, posterior third* (retrolenticular): sensory fibres, and finally *optic radiations*. The motor tracts are most commonly affected, and of these the *face least*. The *localizing symptoms* are thus: *hemiplegia, hemianæsthesia, hemianopia, without convulsions*. *Aphasia* only occurs with bilateral affections ('pseudo-bulbar paralysis').

BASAL GANGLIA.—Small tumours may cause no localizing symptoms. By extension, involve the internal capsule at different sites, causing paralyses.

Intracranial Tumours—Localizing Symptoms, *continued*.

OPTIC THALAMUS.—*Thalamic syndrome** (Roussy): (1) Persistent *hemianæsthesia*, especially to deep sensibility, but also to touch, pain, and temperature. (2) Slight transient hemiplegia without contractures. (3) Hemiataxia (slight) and astereognosis. (4) *Severe, persistent, and paroxysmal pains* on affected side. (5) Tremor, or choreic or athetotic movements, on affected side.

CORPORA QUADRIGEMINA.—(1) *Disturbance of equilibrium*, causing reeling gait. (2) *Ocular symptoms*: nystagmus, loss of pupil reflexes. *Crus* usually involved, whence: (3) *3rd nerve paralysis*, especially *ptosis*. (4) Crossed hemiplegia. *Anterior body* is connected with visual tracts, and *posterior body* with auditory tracts; if latter affected, hearing diminished, especially on opposite side.

CRUS.—‘*Crossed paralysis*’: (1) 3rd nerve on same side. (2) Hemiplegia on opposite side. May also be hemianæsthesia, if fillet affected; lesions of 4th and 6th nerves.

[*Tegmentum*.—If the nucleus ruber, and the connecting superior cerebellar peduncle (the cerebello-rubral system), be affected, a syndrome occurs: (1) Coarse tremor; (2) Loss of emotional movements of face; (3) Ataxia. (Gordon Holmes.)]

PONS.—Tubercle and glioma are not uncommon; glioma may become large without causing localizing symptoms, by surrounding, without destroying, nerve fibres. Optic neuritis also unusual or late. Symptoms very variable.

‘*Crossed paralysis*’ usual, many variations: (1) *6th and 7th nerves and pyramidal tract*; whence (a) facial paralysis on side of tumour, (b) conjugate deviation of eyes to opposite side (*see* SIXTH CRANIAL NERVE), (c) hemiplegia of limbs on opposite side. (2) *5th nerve and pyramidal tract*; whence (a) anæsthesia of face on same side, (b) complete hemiplegia on opposite side. (3) In addition to last, the fillet may be affected, whence anæsthesia of limbs on opposite side to face, i.e., *crossed sensory paralysis* (the motor tracts may escape).

Note.—Tumours of pons may also involve 6th nerve below its nucleus, affecting the rectus externus only, not causing conjugate deviation.

Extension of tumour may cause: (1) Bilateral symptoms, common; combinations of above paralyses. Also anarthria. (2) Involvement of cranial nerves, e.g., 8th (deafness). (3) Involvement of medulla (dysphagia). (4) Involvement of middle cerebellar peduncles (ataxia). (5) Distension of ventricles.

MEDULLA.—Primary tumour very rare. Affects: (1) Cranial nerves, 9th, 10th, 11th, and rarely 12th. Difficulty in

*Investigated by Head and Gordon Holmes. *Croonian Lectures*, 1911.

articulation and swallowing; irregular heart and respiration. (2) Motor tracts: hemiplegia. By extension, usually also cerebellum and pons.

FRONTAL OR CRURIO-ROSTRAL ANGLE. **TUMOURS OF NERVE ACROSSERS.** (Also known as 'extracerebellar' tumours.) Not uncommon. Circumscribed and encapsulated. Excision often definite. Operative removal frequently possible. *Origin:* (1) From cranial nerves, especially *branch of auditory nerve*; pathology doubtful (fibrosarcoma). (2) Surface of cerebellum, less commonly; usually phoma. (See also NEUROMATOSIS, p. 929.)

General symptoms: absent or late

Localizing symptoms: from compression of (1) cranial nerve, (2) cerebellum, (3) pons

1. Cranial nerves: *Earliest symptoms* on side of tumour. Order of affection: (i) 8th nerve: nerve deafness, becoming complete, also tinnitus. (ii) 7th nerve: slight facial paralysis, and 6th nerve, external rectus only. (iv) 5th nerve: tingling in area

2. Cerebellum: Homolateral ataxia, paresis, and atony. Vertigo. Nystagmus.

3. Pons: Hemiplegia on opposite side, usually slight contralateral spastic paralysis

From extra-cerebellar tumours: (1) Nerve deafness on side of tumour, tinnitus. Also 5th nerve. (2)

Paresis of limb on opposite side. (3) Plantar reflex often extensor. (4) Vertigo: sensation of rotating. (5) *On side of lesion* (opposite in cerebellar tumours)

By other process: note, crossed paralysis, conjugate deviation, sensory changes, indefinite vertigo.

In tumours from base of skull, posterior fossa, note: deafness, complete, pain in 5th nerve more marked, cerebellar symptoms later. Often very difficult.

In intracranial disease: Barany's tests, e.g. symptoms induced by injection of hot water into external auditory meatus; also other tests

TUMOURS ARISING FROM BASE OR SURFACE. Usually sarcoma.

May perforate into nasopharyngeal cavity or orbit. *Symptoms:* mainly by compression of cranial nerves; general symptoms often late. *From anterior fossa:* nerves of eye affected, blindness, and ocular paralysis, may be protrusion of eyeball (orbit invaded), anosmia, mental changes (frontal lobe). *Middle fossa:* especially 5th nerve (pain, impaired sensation, inflammation of eye, wasting of motor); by extension of tumour, 7th, 8th, and ocular nerve, innominate gyrus. *Posterior fossa:* 5th, 6th, 7th, and 8th nerves, later pons and cerebellum.

PITUITARY GLAND. See p. 908.

CEREBELLUM. See p. 1039.

Diagnosis.—*Questions arising are:* (1) Is a tumour present? (2) Where is it situated? (3) What is its character?

Intracranial Tumours—Diagnosis, continued.

1. **PRESENCE OF TUMOUR.**—Mainly decided by general symptoms, headache, vomiting, and optic neuritis. Difficulties from :—

- i. **NEPHRITIS, URÆMIA, AND SPREADING ŒDEMA OF BRAIN.**—Similar syndrome occurs and retinitis may be absent. Albuminuria and casts present. Albuminuria may be scanty (chronic interstitial nephritis), but if so and above symptoms present, arteriosclerosis is always advanced.
- ii. **INTRACRANIAL ABSCESS.**—Note : primary focus, pyrexia, signs of sepsis, leucocytosis. Choked disc very rare.
- iii. **HYSTERIA.**—Early tumours may simulate hysteria.
- iv. **DEMENTIA PARALYTICA.**—Occasional confusion with tumours of frontal lobe.

Also occasionally : lead encephalopathy, cerebral vascular lesions, local meningitis, hydrocephalus. In hypermetropia, headache, vomiting, and congestion of discs may occur.

2. **SITUATION OF TUMOUR.**—See LOCALIZING SYMPTOMS.

3. **CHARACTER OF TUMOUR.**—(Wassermann reaction at earliest moment.) Tubercle : especially in children and in cerebellum. Syphiloma : usually on cortex, hence convulsions. Decisior usually impossible.

Radiography.—Can give information on :—

1. **ABNORMALITIES OF BONES.**—(a) Rise of intracranial pressure may cause general 'convolutional thinning' of skull with 'beaten silver' appearance (normal in children) ; (b) Local erosions—e.g., clinoids—from local tumour or rise of pressure.
2. **CALCIFICATION OF TUMOUR.**—E.g., cysts of Rathke's pouch.
3. **ALTERATION IN POSITION OF PINEAL GLAND.**

VENTRICULOGRAPHY, injection of air into ventricles, also employed.

Course and Prognosis.—Symptoms slowly progress. Paralyse occurring are permanent. *Duration of life* from onset of symptoms rarely exceeds two years.

SYPHILOMA.—Only curable tumour.

GLIOMA.—Rarely, duration ten or more years.

TUBERCLE.—Rarely, may become quiescent.

PROGNOSIS BAD.—With rapid optic neuritis, persistent vomiting or convulsions, definite mental symptoms.

DEATH.—Occurs : (1) From coma ; (2) From exhaustion, headache, and vomiting ; (3) Suddenly, tumours usually affecting medulla. Occasionally from meningitis, generalized tuberculosis, secondary growths, hæmorrhage, etc.

Treatment.—

A. **MEDICAL.**—In syphiloma, antisyphilitic treatment (*trephining previous to treatment must be considered*). General medical treatment palliative in other forms. *Headache* : ice-bags, phenacetin ; but if severe, needs morphia. *Convulsions* : bromides of little use.

B. SURGICAL.—Consider immediately on diagnosis. Objects: (1) Removal of tumour, especially endothelioma; (2) Decompression to lower pressure and save sight.

HYPERTONIC SOLUTIONS.—Reduce intracranial pressure. Useful for: (1) Relief of headache; (2) May restore consciousness in coma; (3) To dry brain for operation.

METHODS. (1) *Intracranous injections*: NaCl 30 per cent or glucose 50 per cent; inject 30 c.c. at 3 c.c. per minute. (2) *Oral*: mag. sulph. 30 to 60 gr. repeatedly (slow action). (3) *Rectal*: mag. sulph. 25 per cent, inject 200 c.c. Intake of fluid must be restricted.

IV. ABSCESS OF THE BRAIN.

Etiology.—Probably always secondary.

TRAUMA. Not uncommon. Abscess usually at site of injury.

EXTENSION OF LOCAL INFLAMMATION. Commonest cause.

FOCI: (1) *Middle-ear disease*, usually chronic, spreads by caries through roof of the tympanum or by vessels. *Site of abscess*: commonly temporal lobe. (2) *Mastoid-cell suppuration*. *Site*: commonly cerebellum. Sinus thrombosis frequent. Less commonly: (3) *Frontal and accessory nasal sinuses*. *Site*: frontal lobe. (4) Syphilitic and tuberculous caries of bone. (5) Facial erysipelas, carbuncle, etc. (rare)

DISTANT SEPSIS. Unusual cause. (1) Pulmonary sepsis, e.g., bronchiectasis, pulmonary abscess. (2) Pyæmia and infective endocarditis. Small multiple abscesses may occur. (3) Influenza, enteric fever: rarely. Rarely in empyema, sepsis of liver or bone. *Site of abscess* depends on origin: (1) *Temporal lobe* most common, especially 3rd convolution. (2) Cerebellum.

Morbid Anatomy.—Usually single, except in general pyæmia. *Size*: often about that of walnut.

ACUTE ABSCESS. Not definitely limited; surrounding œdema.

CHRONIC ABSCESS. Often definite capsule. Contains green pus with offensive odour (probably anaerobic organisms).

BACTERIOLOGY. Various micrococci and bacilli. May be sterile. Path of infection not always recognizable.

Symptoms.—Vary greatly according to site of abscess, symptoms of primary disease, and of ancillary disease, e.g., sinus thrombosis, meningitis.

COURSE may be: (1) *Acute*, especially after injury; duration two to three weeks. (2) *Latent*: may be several months (also occurs after injury). (3) *Chronic*, especially in ear group.

STAGES may be recognizable: (1) *Invasion*, headache and malaise; (2) *Latent*; (3) *Terminal*, due to (a) spreading inflammatory œdema, or (b) rupture of abscess causing meningitis, or into ventricles.

Symptoms resemble rapidly-growing tumour: (A) General; (B) Localizing.

Abscess of the Brain—Symptoms, *continued*.

A. GENERAL SYMPTOMS.—Less marked than in tumours.

HEADACHE.—Rarely absent.

OPTIC NEURITIS.—Less frequent and marked than in tumour.

VOMITING AND VERTIGO.—Mainly in cerebellar abscess.

MENTAL CHANGE usual. Drowsiness and apathy. Later, stupor and coma.

PULSE.—Often slow. In terminal stage, rapid or irregular.

TEMPERATURE.—In latent and uncomplicated forms, is usually normal or subnormal. Rises in terminal stage; high with sinus thrombosis or rupture into ventricles.

RESPIRATION often slow, especially in cerebellar abscess.

ANOREXIA, furred tongue, and some septic absorption not uncommon.

LEUCOCYTOSIS.—Often marked, but not invariable.

In '*acute*' forms, signs of sepsis and meningeal irritation more definite: pyrexia, irritability or delirium, rigors.B. LOCALIZING SYMPTOMS (*see* INTRACRANIAL TUMOURS for details).—Accurate localization usually not possible. Of special sites:—TEMPOROSPHEOIDAL ABSCESS.—May be: (1) *Deafness* on opposite side. (2) Taste and smell affected, rarely. (3) Incomplete *word-deafness* (if on left). (4) Superficial abdominal reflexes lost on opposite side. *Pressure effects* when growing: (a) downwards, 3rd and 6th nerve; (b) inwards, internal capsule; (c) angular gyrus, word-blindness, hemianopia; (d) sensory and motor cortex.CEREBELLAR ABSCESS.—General symptoms marked; nystagmus to side of lesion. *Lies on opposite side*, with eyes also away from lesion. Ataxia and paresis on side of lesion. Reeling gait.**Diagnosis.**—General considerations suggesting abscess: (1) *Symptoms of tumour with pyrexia*; (2) Cessation of discharge in chronic otitis media; (3) Suggestive symptoms following injury, or in presence of other etiological factors. In doubtful cases these etiological factors must be sought for to ascertain presence at the time or their history in the past.**SPECIAL DIAGNOSIS** from: (1) *Mastoiditis*. Drowsiness and optic neuritis suggest abscess. (2) *Meningitis*. Usually definite pyrexia, irritability, photophobia, and, may be, convulsions. Cerebrospinal fluid under pressure; may contain pus-cells and micro-organisms. (Septic meningitis may follow otitis media and coexist with abscess.) (3) *Sinus thrombosis*. Usually abrupt onset, high temperature, rapid pulse, rigors, with swelling and tenderness at exit of internal jugular vein. May coexist with abscess. (4) *Intracranial tumour*. Progress more gradual; optic neuritis usually early and marked; no leucocytosis; no etiological factors of abscess.**Treatment.**—*Operation and drainage* at earliest moment. Subsequent mortality occurs from: (1) Meningitis and encephalitis. (2) Exhaustion, especially in late operations. (3) Sinus thrombosis

and general septicæmia. (4) Multiple abscesses. (5) Abscess insufficiently drained. (6) Pulmonary disease and other causal conditions. In absence of operation, invariably fatal.

V. CEREBRAL PALSIES OF CHILDREN.

Characterized by paralysis of upper motor neuron type with certain accessory symptoms. Cause may arise at, after, or (probably) before birth. Main types are hemiplegia and diplegia.

1. INFANTILE HEMIPLEGIA.

Etiology.—Onset from birth or under 2 years. Rare over 5 years.

Causes.—(1) *Injury at birth*, especially from forceps: meningeal hæmorrhage, or other injury to cortex. (2) *Acute polio-encephalitis*: cerebral equivalent of acute poliomyelitis. (3) *Hæmorrhage*, thrombosis, and embolism as in adults. Rare, and usually in the older children. Bleeding commonly from veins, e.g., pertussis, severe convulsions.

Morbid Anatomy.—Gross changes, examined long after onset, are: (1) *Atrophy and sclerosis of brain*. Usual form, especially from acute encephalitis. Area, from small portion to entire hemisphere. Meninges adherent, brain substance hard. (2) *Por-encephaly*, viz., cysts on surface with deficiency of brain tissue, may communicate with ventricles. Origin may be (a) hæmorrhage at birth, (b) possibly defective development.

Symptoms.—

ONSET IN ACUTE ENCEPHALITIS.—Sudden. Age usually 2 to 5 years. Symptoms: (1) *Pyrexia*; (2) *Loss of consciousness*—few hours to days; (3) *Convulsions*, local or general—occasionally absent.

HEMIPLEGIA.—Noticed on return of consciousness; may be partial at first and extend with recurring convulsions; commoner on right side.

RESIDUAL SYMPTOMS (for all forms).—

1. **PARALYSIS.**—May recover almost completely, especially face and leg more rapidly than arm. '*Residual paralysis*' common: (i) Hemiplegic gait; (ii) Upper limb flexed at elbow and wrist, fingers flexed at metacarpophalangeal joint, and extended at others. *Reflexes* increased. *Sensation* unchanged. *Arrest of development*: affected limbs smaller, face may be asymmetrical.

2. **MENTAL DEFECTS.**—Common. All grades from 'backwardness' to idiocy. *Aphasia*: not uncommon if onset when child can speak; if earlier, may learn to use opposite hemisphere.

3. **INVOLUNTARY MOVEMENTS.**—Common. (i) *Post-hemiplegic chorea*: vary from tremors to severe choreiform movements. (ii) *Athetosis*: slow, involuntary, more or less rhythmical movements of extremities, usually of fingers, from position of supination, extension, and abduction, to pronation, flexion, and adduction.

Infantile Hemiplegia—Symptoms, *continued*.

4. EPILEPSY.—Common: *petit mal*, Jacksonian, or general convulsions. Distribution extends with repetition.

Prognosis.—*Paralysis* often improves to an unexpected degree. Bad features are: (1) Mental defects (influencing treatment). (2) *Athetosis*. (3) Epilepsy: tends to produce, or increase, mental defect.

Treatment.—

FEBRILE STAGE.—Bed. Purge. Ice to head. Chloroform if recurrent convulsions.

RESIDUAL PARALYSIS.—Indications: to maintain nutrition of muscles and prevent contractures. *Massage* over long periods. *Exercises*, active and passive.

CONTRACTURES.—Treatment by operation (tenotomies, etc.) and apparatus.

EPILEPSY.—Bromides usually fail; borax recommended.

MENTAL DEFECTS.—Long and careful education necessary.

2. CEREBRAL DIPLEGIA.

(*Little's Disease. Spastic Paralysis of Infants.*)

Etiology.—Practically always present from birth. Often first or difficult labours.

Causes.—(1) *Injury at birth*. Hæmorrhage possibly from longitudinal sinus or veins. (2) *Defective development* of motor cortex and tracts.

Morbid Anatomy.—Changes may be: (1) Atrophy and sclerosis; (2) Commonly *porencephaly*.

Symptoms.—Often first noticed from delay in walking or sitting up. *Convulsions* may occur in infancy.

1. PARALYSIS AND RIGIDITY.—*Legs* more affected than arms; *spasm of adductor muscles of thighs*, knees flexed, heels drawn up by calf muscles; hence, when held up stands on toes and inner side of feet, or legs crossed; may be 'scissors gait'. *Arms*: deficiency often slight; may be flexed joints. *Face* often escapes, or involuntary grimaces occur. *Reflexes* increased; plantar reflex extensor (*N.B.*—Normally so in infants). *Sensation* normal. No wasting.
2. MENTAL DEFECTS.—All grades. (*See* INFANTILE HEMIPLEGIA.)
3. INVOLUNTARY MOVEMENTS.—Various. Spastic movements when attempting to seize objects. Also 'post-hemiplegic chorea' and 'athetosis' (*see* INFANTILE HEMIPLEGIA), may be bilateral and very extensive.
4. EPILEPSY AND CONVULSIONS.

Diagnosis.—Simple. May resemble syphilitic meningo-encephalitis. 'CONGENITAL SPASTIC IDIOCY'.—Applied to type with dementia and slight rigidity.

'LITTLE'S DISEASE'.—Especially applied to paraplegia.

Prognosis and Treatment.—*See* INFANTILE HEMIPLEGIA.

CEREBELLAR PALSIES.

Etiology.—Resembles that of cerebral palsies.

Groups (Batten).—(1) *Congenital cerebellar ataxia*. From birth (cf. CEREBRAL DIPLEGIA). (2) *Acute cerebellar ataxia*. Onset from birth, or following acute fevers or encephalitis. These forms tend to improve. (3) *Progressive cerebellar ataxia*.

VI. HYDROCEPHALUS.

Properly, any accumulation of serous fluid within the cranium. (a) *Hydrocephalus externus*, fluid between cortex and skull. Occurs in atrophy of brain, old age, general wasting, hæmorrhage, etc. Not further referred to here. (b) *Hydrocephalus internus*, increase of fluid in the ventricles.

Internal Hydrocephalus.—

MODES OF PRODUCTION. Increase of fluid in the ventricles might occur from :—

1. **EXCESSIVE FORMATION OF FLUID**—(Evidence experimental only.)

a. Great vein of Galen drains choroid plexuses. Vein may be blocked by thrombosis or pressure by sub-tentorial tumour.

b. Fall in osmotic pressure of blood increases formation of fluid (and vice versa).

2. **OBSTRUCTION TO CIRCULATION.**—Usual cause. See below.

3. **DEFECTIVE ABSORPTION.**—Might occur from thrombosis of intracranial sinuses. Rare, and doubtful as sole cause.

OBSTRUCTION TO CIRCULATION.—Fluid arises from choroid plexuses in lateral, 3rd, and 4th ventricles : probably a dialysate. Results vary according to site of obstruction :—

1. **FORAMEN OF MONRO.**—Fluid passing from lateral to 3rd ventricle.

Obstruction.—Tumour of choroid (rare).

Result.—Dilatation of affected lateral ventricle.

2. **SYLVIAN AQUEDUCT.**—Fluid passing from 3rd to 4th ventricle.

Obstruction.—Tumours of pons and medulla and in neighbourhood of mid-brain.

Result.—Dilatation of both lateral and 3rd ventricles.

3. **FORAMEN OF MAGENDIE AND TWO LATERAL FORAMINA OF LUSCHKA.**—Fluid passes into subarachnoid space, the cisterna magna (subtentorial) : (small amount into central canal of cord.)

Obstruction.—(a) By meningeal adhesions from meningitis ; (b) Tumour pressing down medulla and cerebellum into foramen magnum, 'cerebellar pressure cone'.

Result.—Dilatation of lateral, 3rd, and 4th ventricles.

Note.—From cisterna magna, fluid passes into (i) Subarachnoid space of cord and is partly absorbed in theca spinalis ; (ii)

Internal Hydrocephalus—Obstruction to Circulation, *continued*.

Through the chiasma tentorii in tentorium to cisterna basalis (supratentorial).

4. CHIASMA TENTORII.—

Obstruction.—(a) Meningeal adhesions; (b) Cerebral tumours or abscess.

Result.—'Communicating hydrocephalus'—viz., dilated ventricle and increased spinal pressure as shown by lumbar puncture.

Note.—From cisterna basalis, fluid spreads over brain. Is absorbed *through* arachnoid villi (Pacchionian bodies) into venous sinuses; also escapes into sinuses along perivascular spaces surrounding arteries.

SUMMARY OF CAUSES.—(1) Meningitis—syphilis or meningococcus; (2) Tumours, especially in posterior cerebral fossa; (3) Thrombosis—vein of Galen or cerebral venous sinuses.

SYMPTOMS.—Variable. Headache, slow pulse, vomiting, papilloedema or atrophy and blindness; may be convulsions or prolonged coma, spasticity of arms and legs. May resemble tumour. Head enlarges if skull bones not united.

DIFFERENTIAL DIAGNOSIS OF SITE.—Methods include: ventriculography, encephalography, pressure tests, and dye tests.

TREATMENT.—No satisfactory operation.

CONGENITAL HYDROCEPHALUS.—May be present at birth and obstruct labour. Most commonly cranial enlargement commences subsequently. Pathology unknown: ventricular foramina not always obstructed; sometimes congenital syphilis. Spina bifida may coexist.

GENERAL DESCRIPTION.—*Skull* enormously enlarged, with face of normal size. Bones thin, sutures wide, Wormian bones numerous. Ventricles greatly distended, and brain substance very thin. Fluid clear. Ependyma may be granular, but signs of inflammation rare; also in choroid plexus.

SYMPTOMS.—Convulsions, general spasticity, and increased reflexes common. Mental condition: various degrees of deficiency, rarely normal.

Death usually within three or four years.

IDIOPATHIC INTERNAL HYDROCEPHALUS (*Quincke's serous meningitis*).—Rare condition, occurs in children or adults. Ascribed to ependymitis producing serous effusion into ventricles; symptoms, resulting from distension, resemble meningitis or tumour. Cause unknown. Great improvement follows lumbar puncture.

ACUTE.—Resembles meningitis: headache, head retraction, slow pulse, optic neuritis. May be afebrile.

CHRONIC.—Resembles tumour. Headache, optic neuritis, etc. may be drowsiness or coma of several weeks' duration. Convulsions and cranial nerve paralysis.

PROGNOSIS.—Recovery may occur. Accounts for some apparent recoveries from intracranial tumour and meningitis.

VII. AMAUROTIC FAMILY IDIOCY.

(Tay-Sachs' Disease.)

A fatal disease of infants characterized clinically by progressive mental, motor, and visual failure, and by pathognomonic changes in the retina; and pathologically by swelling of the cytoplasm of the cells of the central nervous system.

[A juvenile type, onset between 6 to 14 years, is at present unconfirmed.]

Etiology.—Symptoms appear between 3rd and 6th month. *Familial factor* marked; almost, if not entirely, confined to Hebrews. No relation to syphilis, or trauma at birth: consanguinity may be present.

Morbid Anatomy.—Characteristic change in cells of nervous system: protoplasm greatly swollen and cellular network absent, cells presenting 'ballooned' appearance, with nucleus pushed aside and often destroyed; dendrites swollen, but axon little affected. Widespread, and few cells escape in cortex, ganglia, or cord. No signs of inflammation; neuroglial proliferation slight and secondary. May be some atrophy and sclerosis of convolutions. Ganglion cells in retina similarly affected and cause of specific appearance at macula.

Pathogenesis.—An inborn error of lipid metabolism. May be a localized manifestation of Niemann-Pick's Disease (see LIPOIDOSES).

Symptoms.—Infant appears normal at birth and until three to six months.

INITIAL SYMPTOMS.—Weakness of neck and back muscles, unable to sit up, head falls forward. Vision defective.

PROGRESS AND CHARACTERISTIC SYMPTOMS.—

1. IDIOCY develops.
2. PARALYSIS becomes complete; unable to move; wasting extreme.
3. BLINDNESS becomes total.
4. PATHOGNOMONIC BILATERAL RETINAL CHANGE—At macula an oval white area, larger than the optic disc, with a central 'cherry red spot' (fovea). Also optic atrophy.

Spasticity may, or may not, develop, with increased reflexes, spasms and contractures, but never marked. No convulsions. No sensory changes.

Occasionally: Slow lateral nystagmoid movements. Hyperacusis.

Course.—Fatal at 1½ to 2½ years.

Diagnosis.—By family history, progressive mental, motor, and visual changes, absence of convulsions, and by pathognomonic appearance of retina.

Treatment.—Palliative. Weaning useless (Sachs).

VIII. PROGRESSIVE LENTICULAR DEGENERATION.

(*Hepato-lenticular Degeneration.*)

Recognized and described by Kinnier Wilson (*Brain*, 1904 and 1912).

Morbid Anatomy.—Two main lesions: (1) Bilateral softening of the lenticular nucleus, especially the putamen. (2) Cirrhosis of the liver: not identical with ordinary types.

Etiology.—*Onset in youth. Familial*, but not hereditary or congenital.

Pathogenesis.—Unknown. Cirrhosis appears to be result of recurrent attacks of acute hepatitis.

Manifestations.—(1) Rhythmical tremors; (2) Spasmodic contractions and involuntary movements; (3) Rigidity—commencing in face, extends until entire body helpless—difficulty in articulation and swallowing early; (4) Emotional and often mental changes; (5) Zone of corneal pigmentation (Kayser-Fleischer); (6) Emaciation. No nystagmus. No retinal and no sensory changes. Reflexes normal. Is entirely extrapyramidal.

CIRRHOSIS OF LIVER.—Usually no symptoms. Occasionally attacks of acute hepatitis.

Course.—Progressive. Fatal. *Duration*: a few years. No obvious symptoms from the cirrhosis.

IX. ACUTE DISSEMINATED ENCEPHALOMYELITIS.

An inflammation of the brain and spinal cord characterized especially by perivascular demyelination; mainly in association with infectious diseases.

Identity of various groups is unproved: clinical symptoms and pathological changes are in general agreement.

Occurrence.—(1) Post-vaccinal. (2) Infectious fevers: measles, mumps, small-pox. Also: chicken-pox, scarlet fever, diphtheria, whooping-cough. (3) Encephalitis periaxialis diffusa. (4) Idiopathic.

DEMYELINATION also occurs in: (a) Disseminated sclerosis; (b) Neuroptico-myelitis (Devic)—paraplegia and loss of vision; (c) Cerebral syphilis and syphilis treated with salvarsan (rarely). Encephalitis lethargica and polio-encephalitis resemble these, but do not show demyelination.

Morbid Anatomy and Symptoms.—See POST-VACCINAL ENCEPHALITIS, p. 257.

X. ENCEPHALITIS PERIAXIALIS DIFFUSA.

(*Schilder's Disease.*)

A rare disease characterized by demyelination of nerve fibres in the white matter of the brain.

Etiology.—Children and young adults. No factors known.

Morbid Anatomy of Brain.—

MACROSCOPIC.—Shrunken. In white matter, grayish or reddish-brown hyaline areas, slightly translucent and sharply demarcated: either soft or hard. Occipital and temporal lobes most affected. Appears to extend forwards: often cerebellum involved.

MICROSCOPIC.—Myelin destroyed; secondary degeneration of axis cylinders. Infiltration with round cells.

Symptoms.—

ONSET OF SYMPTOMS.—Rapid: with malaise and headache; no pyrexia.

CEREBRAL BLINDNESS.—Early. Either: (a) Bilateral—total blindness; or (b) Unilateral—homonymous hemianopia. Pupil reflexes normal.

MENTAL IMPAIRMENT.—From dullness to dementia.

EPILEPTIFORM AND JACKSONIAN CONVULSIONS.—All types.

PROGRESSIVE SPASTIC PARALYSES.—Note: Cranial nerves rarely affected (except sixth). Papilloedema rare. Diplopia and nystagmus common.

OTHER SYMPTOMS.—Speech defects. Giddiness. Deafness.

CEREBROSPINAL FLUID.—Normal.

Course.—Progressive with remissions. *Duration:* few months to two or three years.

Treatment.—Symptomatic.

Diagnosis.—From cerebral tumour by scattered symptoms. Difficult in rare cases with papilloedema and vomiting. Also from disseminated sclerosis.

CHAPTER CLXXI.

VASCULAR LESIONS OF THE BRAIN.

I. CEREBRAL HÆMORRHAGE.

(*Apoplexy.*)

Ætiology (factors associated with degeneration of vessels).—

AGE.—Especially 40 to 60 years; rarely under 40.

SEX.—Males common (from predisposing factors).

HEREDITY.—Familial tendency to vascular degeneration occurs. Also plethoric build.

PREDISPOSING FACTORS.—(1) *Chronic interstitial nephritis and causes of arterial degeneration and high blood-pressure, viz., alcohol, over-eating, syphilis, chronic muscular strain, gout, and lead.* Cardiac hypertrophy common. Other occasional causes: (2) Infective endocarditis, with embolism and aneurysm. Rarely: (3) Acute specific fevers. (4) Temporary high blood-pressure, e.g., whooping-cough paroxysms, parturition. (5) Anæmia. Also: (6) Birth injuries.

Cerebral Hæmorrhage—Etiology, continued.

EXCITING CAUSES.—May be none obvious, occurrence not uncommon during sleep. Events affecting circulation: e.g., emotion, muscular strain (e.g., in constipation).

Note.—See also INTRACRANIAL ANEURYSMS, p. 1036.

Pathology.—

VESSELS OF ORIGIN.—Commonest are branches of middle cerebral artery through anterior perforated space, especially: (1) *Lenticulo-striate artery* of Duret (the artery of hæmorrhage): pierces base of brain, enters external capsule, ascends between this and lenticular nucleus, then through the latter and the anterior portion of the internal capsule, finally ending in the caudate nucleus. (2) Lenticulo-optic branches: supply posterior (retro-lenticular) portion of internal capsule. Frequency of rupture ascribed to: (a) Origin at right angles to middle cerebral; (b) Absence of anastomosis ('end arteries').

SITE OF HÆMORRHAGE.—

INTRACEREBRAL HÆMORRHAGE.—(1) *Internal capsule*: commonest site. (Often commences external to capsule.) Lenticular nucleus and optic thalamus may be involved. (2) *Pons*. (3) Less commonly: cortex, centrum semiovale, cerebellum, crus, temporosphenoidal lobe.

MENINGEAL HÆMORRHAGE.—May be extra- or intradural. Occurs in: (1) Fractures and head injuries. (2) Aneurysms—usually middle meningeal artery. (3) Birth injuries. (4) Occasionally: acute infectious fevers, anæmia, extension of intracerebral hæmorrhage. Effusion may be large and flow to base and spinal cord.

INTRAVENTRICULAR HÆMORRHAGE.—Rarely primary. Usually extension from intracerebral hæmorrhage. Tends to flow into opposite ventricle, and also into 3rd or even 4th ventricle.

SUBSEQUENT CHANGES IN THE HÆMORRHAGE.—The effused blood darkens in colour. Subsequently, either: (1) Formation of a wall enclosing a fluid cyst; or (2) Absorption of the blood, proliferation and organization of connective tissue, leaving a pigmented scar. Brain tissue around shows staining.

In meningeal hæmorrhage, blood may be absorbed. With birth hæmorrhages, when profuse, cortex may waste and cysts form (porencephaly).

SECONDARY DEGENERATION OF NERVE FIBRES affected occurs, and can be traced in the tracts involved.

Symptoms.—Characteristics are: (a) Initial phenomena: unconsciousness or coma, 'apoplectic fit'. (b) Paralysis.

PREMONITORY SYMPTOMS OR 'WARNINGS'.—Probably from small hæmorrhages. Frequently absent. Numbness or tingling in limbs; attacks of headache, giddiness, or vomiting; epistaxis; disturbances of vision, retinal hæmorrhages; slight difficulty in speaking or mental disturbance; slight convulsions and choreiform movements.

TYPES OF ONSET.—Vary with the extent and position of the hæmorrhage.

SUDDEN LOSS OF CONSCIOUSNESS.—Not common.

GRADUAL DEVELOPMENT OF PARALYSES AND COMA.—From few minutes upwards. Common form. The longer onsets termed 'ingravescens apoplexy'.

PARALYSIS WITHOUT COMA.—From small central hæmorrhages.
COMA.—Occurs of any depth. May be able to put out tongue, or attempt to speak. Rapid and deep in small hæmorrhages in pons, or large effusions anywhere; marked when intra-ventricular.

CONVULSIONS.—Not common. Most in pontine and cortical hæmorrhages.

APOPLECTIC ATTACK.—*General description* (especially refers to capsular hæmorrhages):—

DEEP COMA.—Rotation of head and eyes common, towards lesion. Face cyanotic, or congested. Respirations slow and noisy, often irregular; lips splutter, cheeks blown out. Pupils inactive, usually dilated; may be unequal; contracted if pontine. Pulse slow, full, incompressible. Temperature normal or subnormal; high if pontine. Reflexes absent. Incontinence of urine and fæces. If hemiplegia: (1) Loss of tone in affected muscles, limbs drop dead; (2) Paralysed cheek blown out on expiration; (3) Chest movement diminished.

Note.—All muscles may be flaccid during coma.

WHEN ONSET LESS ABRUPT.—Gradual loss of power and unconsciousness passing into deep coma. Premonitory symptoms may precede onset. May occur in sleep, and patient may awake paralysed, or be found unconscious. *Paralysis without unconsciousness* may occur with small hæmorrhages in internal capsule.

SUBSEQUENT COURSE WHEN COMA DEEP.—May be: (a) *Death* in a few hours, very rare under an hour. (b) *Consciousness recovered*, then relapse into fatal coma; more frequent, especially when hæmorrhage burst into ventricles. (c) *Consciousness recovered*, usually in about twenty-four hours; passes through *stage of febrile reaction* and early rigidity; subsequently symptoms due to hemiplegia.

CONJUGATE DEVIATION (for mechanism, see **SIXTH NERVE**).—Both eyes and often head rotated to one side: (1) Towards lesion, if this is between cortex and crus; (2) Away from lesion, if in pons. In 'early rigidity' the directions are reversed owing to spasm of muscles.

REFLEXES.—During coma, all reflexes absent; with consciousness they return on unaffected side. On paralysed side the reflexes gradually return, then become *increased*; *plantar reflex extensor* ('positive Babinski's sign'); *ankle-clonus present*. Superficial reflexes diminished.

STAGE OF FEBRILE REACTION.—'*Early rigidity*'. Due to inflammation around hæmorrhage and absorption of blood. Onset 12 to 48 hours after attack.

Cerebral Hæmorrhage—Symptoms, *continued*.

Temperature rises, headache and malaise. Duration, one to several weeks. 'Early rigidity', stiffness of paralysed limbs. Trophic changes, e.g., sloughing at lower part of back, in serious cases. Congestion of base of lungs frequent. Difficulty in speech and mental disturbances common for some days. Sphincters unaffected.

HEMIPLEGIA.—From destruction of motor cortex or pyramidal tracts.

GENERAL CHARACTERISTICS OF PARALYSIS.—Hemiplegia partial or complete, i.e., face, arm, and leg. Initial distribution wider than later, from œdema around lesion and irritation of tracts not destroyed. Extent lessens as site of lesion approaches cortex (rapidly above capsule). *Muscles used symmetrically escape*, especially thorax and abdomen (stimulated from either hemisphere). Muscles used in specialized movements suffer most, e.g., arm more than leg, hand more than shoulder. *Face*: paralysis is partial, frontalis and orbicularis palpebrarum escaping (*see SEVENTH NERVE*); tongue and palate affected; emotional movements suffer less than voluntary. Paralysis of upper motor neuron type (except in crossed paralysis). Psychic disturbance common. Sphincters unaffected. Difficulty in speech or, with right hemiplegia, aphasia may occur. Occasional symptom: *pain in limbs*: infrequent: rarely severe (? optic thalamus lesion).

ORDER OF RECOVERY.—Inverse to frequency and severity of affection, viz., leg before arm, shoulder before hand, thumb last. Face may recover rapidly.

RESIDUAL PARALYSIS.—Tends to involve: (a) *Leg*: flexors of legs and dorsiflexors of foot, i.e., shorteners of leg used in second stage of walking. (b) *Arm*: muscles opening the hand and rotating the arm outwards.

LOCALIZING SYMPTOMS (*see also* INTRACRANIAL TUMOURS, p. 1014).—(Commonest site internal capsule, then pons.)

CORTEX.—Paralysis usually limited, but permanent. May be: convulsions at onset, aphasia.

INTERNAL CAPSULE.—Paralysis is often widespread and permanent. Site of lesion is revealed by extent and distribution of paralysis. Usually in anterior two-thirds of posterior limb. If in posterior third, hemianæsthesia and homonymous hemianopia occur.

CRUS.—*Crossed paralysis*: (1) Third nerve on same side; (2) Face and limbs on opposite side. Hæmorrhage often an extension from internal capsule and then involves fillet, whence anæsthesia on paralysed side. Special senses or optic tract may be affected (hemianopia).

'*Crossed Paralysis or Hemiplegia*'.—A cranial nerve affected on one side (lower motor neuron), and a hemiplegia on the opposite side. Occurs in lesion of crus, pons, and medulla, due to levels of decussation.

PONS.—General symptoms at onset: (a) *Pyrexia*, often 105°; (b) *Pupils contracted* (irritation of third-nerve nucleus);

(c) Convulsions not uncommon ; (d) *Coma* sudden, deep, and may be fatal. Hæmorrhage often affects both sides.

Lower Portion of Pons.—Crossed paralysis : (1) Sixth and seventh nerves, whence (a) facial paralysis on side of lesion, (b) conjugate deviation away from lesion ; (2) Pyramidal tract, whence limbs paralysed on opposite side to lesion.

Middle of Pons (rare).—Crossed paralysis : (1) Fifth nerve on side of lesion, i.e., loss of sensation ; (2) Hemiplegia on opposite side. Fillet may also be involved, i.e., anæsthesia on opposite side (crossed sensory paralysis).

MEDULLA.—Rare : death usually rapid. Crossed paralysis : (1) Twelfth nerve, whence tongue protrudes towards lesion (usually) ; (2) Pyramidal tract, hemiplegia on opposite side.

VENTRICLES.—*Coma* marked. Usually return of coma after an initial recovery of consciousness, from secondary rupture of hæmorrhage into ventricles. Always fatal.

CEREBELLUM.—Rare ; diagnosis difficult. Usually superior cerebellar artery, branch to dentate nucleus. Onset with *vomiting*, *pain* in neck or back of head. Usually fatal from rupture into 4th ventricle. If recovery, localizing cerebellar symptoms (see **CEREBELLUM**, pp. 1038, 1039).

SENSORY CHANGES.—Variable. With hemiplegia, usually slight numbing, hemianæsthesia rare. Lesion in posterior third of internal capsule (retrolenticular portion) may give : (1) *Hemianæsthesia*. (2) *Hemianopia*, homonymous to opposite side. Rarely, other special senses. (3) *Leg* more affected than arm. Anæsthesia, without special senses affected, when fillet involved (see **CRUS** and **PONS**).

Note.—*Protrusion of tongue* : usually deviates to paralysed side (sound genioglossus), but sometimes the reverse ; mechanism unknown.

MENINGEAL HÆMORRHAGE.—

TRAUMA.—At onset may be : *convulsions*, *unequal pupils* (large on side of lesion). Three stages : (i) Unconsciousness ; following injury. (ii) 'Lucid interval' : duration few hours to two or rarely four days. May feel well. (iii) *Coma* develops, spasms, paralysis, and death. Localized by site of spasms. Stages commoner in extradural than subdural forms ; in latter coma rapid, and lucid interval rare.

ANEURYSM.—Source : usually middle meningeal artery. At onset : headache, vomiting, giddiness, and convulsions. Rapid coma.

Sequelæ in Hemiplegia.—

1. **SECONDARY CONTRACTURES**.—'Late rigidity'. Results permanent.

ARM.—Flexion at elbow, wrist, and finger.

LEG.—Contractures less marked.

Gait.—Leg, when walking, is swung in semicircle to prevent toes dragging.

2. **DEEP REFLEXES** increased.

Cerebral Hæmorrhage—Sequelæ in Hemiplegia, *continued*.

3. ATROPHY OF MUSCLES unusual. May occur as result of secondary changes in ventral horns.

4. TROPHIC CHANGES.—Skin thin and glossy.

OCCASIONAL PHENOMENA:—

ASSOCIATED MOVEMENTS.—With strong action of sound limb, movement of paralysed limb may occur. Possibly impulse spreads to opposite side in lower centres.

ATHETOSIS, POST-HEMIPLEGIC CHOREA, ARTHROPATHIES.—Mainly in children (*see* p. 1021).

Note.—Mental powers and concentration usually impaired after apoplexy.

Diagnosis during Coma (*see also* COMA, p. 315).—Obtain if possible: (1) Previous history: prodromata, fits, alcoholism, previous attacks, etc. (2) Mode of onset: injury, drinking, convulsions, rapidity of onset. Examine: (1) Head for injury. (2) Paralysis: cheeks puffed out, limbs flaccid, reflexes, conjugate deviation. (3) Pupils. (4) Heart and pulse. (5) Temperature. (6) Urine.

If paralysis is present, cause is hæmorrhage, embolism, or thrombosis. (For special symptoms, *see* EMBOLISM, p. 1033.)—Diagnosis of thrombosis from hæmorrhage often difficult; former specially suggested by extending paralysis with slight or no loss of consciousness.

Other causes of coma include: alcohol, opium or other narcotic drugs, epilepsy, uræmia, diabetes, various conditions of nervous system, severe hæmorrhage (*see* COMA).

Alcohol, injury, and hæmorrhage often coexist; diagnosis uncertain and catastrophes common; treat all doubtful cases as serious. Alcohol in breath is of no value.

Prognosis.—Serious symptoms are:—

DURING ATTACK.—(1) Coma deep, lasting more than 24 hours; increasing depth suggests ventricular hæmorrhage. (2) Rapid rise of temperature within 48 hours. (3) Conjugate deviation persisting. (4) Respiration irregular or Cheyne-Stokes.

SUBSEQUENT TO ATTACK.—(1) Temperature persisting: should fall on 3rd or 4th day. (2) Acute bedsores. (3) Congestion of lungs. (4) Albuminuria. (5) Bilateral paralysis.

PARALYSIS.—No improvement if not commencing within three months. From cortical hæmorrhage, recovery may be complete; internal capsule, always some permanent paralysis. Contractures are permanent.

MENTAL CONDITION.—Mental powers rarely recovered completely: often irritable.

Treatment.—*See* p. 1035.

II. CEREBRAL EMBOLISM AND THROMBOSIS.

(Cerebral Softening.)

Etiology.—

EMBOLISM.—Origin usually from the heart, fragments arising from: (1) *A diseased valve*, usually mitral; in recurrent or infective endocarditis. Rare in first attack of rheumatic fever or chorea. (2) *An auricular clot*, commonly mitral stenosis, occasionally in puerperium. Rare: (3) Clot from aneurysm; (4) Patch of atheroma; (5) Pulmonary sepsis. (6) Sepsis elsewhere (very rare).

SITE.—Left middle cerebral artery most common.

SEX.—Women commoner, from frequency of heart disease.

AGE.—Mainly young adults.

SEPTIC EMBOLI.—Occur in: (a) Infective endocarditis; (b) Pulmonary sepsis; (c) Rarely sepsis in other parts, e.g., pelvis. (Possibly consist of a few micro-organisms.)

THROMBOSIS.—Causes (aiding coagulation of blood): (1) *Arterial degeneration*, due to (i) arteriosclerosis, (ii) syphilitic endarteritis: lumen narrowed. (2) Blood changes and feeble circulation. Debilitating conditions. Also: (3) Around embolus. (4) Aneurysms. (5) Pressure on vessels by neoplasms.

SITE.—Middle cerebral artery most common.

Pathology.—Characteristic result: degeneration and 'softening' in area deprived of blood. *Initial change* in area affected is *anaemia*. If circulation not re-established by collaterals, subsequent changes are: (1) *Infarction*, anæmic or hæmorrhagic. (2) *Softening*: area affected becomes moist and softens from infiltration with serum, nerve fibres degenerate, neuroglia swells. (3) *Slow removal* of degenerated tissue, proliferation of connective tissue, and *scar formation*; occasionally a cyst forms. *Abscess* forms if embolus infective. *Inflammation* occurs around area involved.

Red, yellow, or white softening depends on amount of blood in area. Red and yellow mainly in the cortex, white in the white matter.

ANASTOMOSIS OF CEREBRAL ARTERIES, AND RESULT OF BLOCKING.—

Central branches, e.g., through anterior perforated space, are pure end arteries, whence softening in internal capsule and corpus striatum.

Cortical vessels.—Establishment of collateral circulation varies; is greater than injection experiments suggest. Branches of middle cerebral are chiefly end arteries, whence focalizing lesions. Collateral circulation greater when main stems blocked, especially in posterior cerebral.

Symptoms.—May be none, especially when 'silent areas' affected, or in elderly persons. In general, resemble cerebral apoplexy in onset: subsequent hemiplegia, transient or permanent. Distinguishing factors:—

EMBOLISM.—(1) Age: young adults. (2) Heart disease common. (3) Onset sudden: no premonitory symptoms. (4) Loss of

Cerebral Embolism and Thrombosis—Symptoms, *continued*.

consciousness rarely deep. (5) Convulsions common (cortex affected). (6) Emboli may also be in retina or other sites.

THROMBOSIS.—(1) Age: syphilis in adults; arteriosclerosis after middle age. (2) Premonitory symptoms common. (3) Onset gradual: paralysis may start in one hand and extend. (4) Loss of consciousness varies with extent of thrombosis: in syphilis usually absent. (5) Convulsions not common at onset.

Previous symptoms or prodromata may exist for weeks, from vascular disease: headache (especially in syphilis), giddiness, tinglings, deficient memory, difficulties in speech.

LOCALIZING SYMPTOMS.—(Commonest site, middle cerebral; next, posterior cerebral and vertebral. Others rare.)

MIDDLE CEREBRAL ARTERY.—(1) Main stem or perforating branches: permanent hemiplegia (internal capsule). (2) Main stem distal to perforating branches: aphasia and hemiplegia, often transient. Branches: (a) Inferior frontal: motor aphasia. (b) Ascending frontal and parietal: complete hemiplegia. (c) Temporo-parietal: word-blindness and right hemianopia. (d) Temporal: word-deafness. (Symptoms of aphasia apply to lesions on left side.)

POSTERIOR CEREBRAL ARTERY.—Homonymous hemianopia and, may be, hemianæsthesia (posterior part of internal capsule). Collateral circulation often fair.

ANTERIOR CEREBRAL ARTERY.—Progressive dementia or nil. Rarely affected.

VERTEBRAL ARTERY.—Usually left. Supplies bulb, but results often partial, or transient, owing to anterior spinal artery. *Acute bulbar paralysis and some hemiplegia.* Lesion often includes:—

BASILAR ARTERY.—Bilateral hemiplegia and bulbar paralysis with pyrexia, as in pontine hæmorrhage. Usually rapid death in coma.

INTERNAL CAROTID.—Variable symptoms, depending on freedom of anastomosis: often none; may be hemiplegia, transient or permanent. Thrombosis may spread into branches, whence hemiplegia and coma, usually fatal.

POSTERIOR INFERIOR CEREBELLAR ARTERY.—*See VASCULAR LESIONS OF THE CEREBELLUM, p. 1039.*

Combined lesions occur, e.g., both posterior cerebrals, or one with opposite middle cerebral: *apraxia* often marked.

Prognosis.—**A. DURING ATTACK.**—

THROMBOSIS.—Serious if previous attacks, extensive disease of vessels, or in prolonged coma. Varies with site: recovery rare if basilar, internal carotid, or both middle cerebrals thrombosed.

EMBOLISM AND SYPHILITIC THROMBOSIS.—Rarely fatal, unless basilar affected. In these also second attacks rare (if syphilis treated); not uncommon in other forms of thrombosis.

B. PARALYSIS.—Unless improvement commences in two or three weeks, recovery is exceptional. Prognosis worse in thrombosis than embolism, owing to vascular disease.

Note.—Extent of paralysis at onset is not always the maximum, as the extent may increase with advance of thrombosis.

In general: prognosis for life good, but for recovery from paralysis poor.

TREATMENT OF CEREBRAL HÆMORRHAGE AND SOFTENING.

All movements to be avoided. Should not be roused from coma. Avoid active measures while diagnosis uncertain.

HÆMORRHAGE.—

In acute stage.—(1) Place in bed at *absolute rest*. Head somewhat raised. Neck free and not bent. *Turn on side if respiration impeded*. Wipe out mouth frequently. (2) Hot bottles to feet. Ice-bag or cold to head. (3) Bowels open: but not excessive purging. (4) *No alcohol* or stimulants. Food unnecessary. Fluids if coma prolonged. (5) Blood-letting. Indications: full tense pulse, cyanosis and distended cervical veins, stertorous respiration. Contra-indications: small weak pulse. Remove 8 to 10 ounces once only. Hypertonic solutions (*see* INTRACRANIAL TUMOURS, p. 1019). *Trephine* for meningeal hæmorrhage, remove clot, and ligature vessel or plug with sterile wax.

After acute stage.—Rest in bed two to four weeks. Avoid bed-sores: keep skin clean and dry, prevent burns from hot bottle. Light diet. No alcohol, digitalis, or drugs (except placebo or for intercurrent affection).

EMBOLISM AND THROMBOSIS.—

1. Place in bed with foot slightly raised. Keep warm.
2. *Stimulants* if heart feeble: brandy, ammonia, ether, or digitalis.

3. Contra-indicated are: venesection, free purging.

Amyl nitrite recommended by some authorities.

If *syphilitic*: treatment at once. Commence with mercury injections or inunctions.

PARALYSIS.—Wrap limbs in cotton-wool. Light massage after ten days. Electricity after two to four weeks, especially faradic current to muscles antagonistic to contractures. Encourage use of recovering muscles. Treatment useless after three months and with contractures present.

III. THROMBOSIS OF THE CEREBRAL SINUSES.

Primary Simple Thrombosis.—Rare.

ETIOLOGY.—(1) Weakly infants, especially with diarrhoea; or in old people: 'marantic thrombosis'. (2) Anæmia and chlorosis: rare: 'autochthonous sinus thrombosis'. Usually in superior longitudinal sinus.

Thrombosis of Cerebral Sinuses—Primary Simple, *continued*.

SYMPTOMS.—Mental dullness, headache, vomiting or convulsions. May be thrombosis elsewhere, e.g., legs. 'Marantic thrombosis' often latent, found at autopsy.

Secondary Thrombosis.—Not uncommon. Due to extension of inflammation from structures near: usually septic.

CAUSES.—(1) *Middle-ear disease*, commonest cause. Usually chronic disease. More often through posterior wall of middle ear than from mastoid cells. (2) *Tuberculous caries of temporal bone*. (3) *Suppuration outside skull*, rare: erysipelas, carbuncle, disease in nose, throat, or orbit. Occasional causes: fractures, compression by tumours.

SITE.—*Lateral sinus* most common, from otitis media. Cavernous sinus, etc.

SYMPTOMS.—*Septicæmia with local symptoms*.

ONSET.—Usually sudden: pyrexia, rigors, sweats. Headache; often drowsy.

LATERAL SINUS.—Tenderness and œdema behind ear and in neck. Internal jugular vein may be involved: palpable as hard cord, pain on using neck muscles. If condition progresses, pneumonia, pulmonary sepsis, general pyæmia, and death.

CAVERNOUS SINUS.—œdema of eyelids, exophthalmos, may be retinal hæmorrhages. Ocular nerves and 1st division of 5th nerve may be affected in wall of sinus, with resulting paralyses, corneal ulceration, and occasionally optic neuritis.

TREATMENT.—*Lateral sinus*: operation and evacuation of contents. Prognosis improving with early treatment, but always grave. *Cavernous sinus*, inoperable.

IV. INTRACRANIAL ANEURYSMS AND ANGIOMATA.

Aneurysm of larger arteries uncommon. Miliary aneurysms occur on branches of middle cerebral: little importance.

Three Principal Groups.—

1. Saccular arterial aneurysms.
2. Angioma.
3. Angioblastoma.

1. SACCULAR ARTERIAL ANEURYSM.

Causes.—(1) Congenital deficiency of media. (2) Infective embolus. Symptoms of cerebral embolism followed by rupture and 'sub-arachnoid hæmorrhage' (*see below*). Syphilis: only in basilar aneurysm. Arteriosclerosis: doubtful cause.

Congenital Intracranial Aneurysm.—Not uncommon. Site: close to circle of Willis: usually at branching of arteries, e.g., middle or anterior cerebral. Size: about pea ('berry' aneurysm). Single or multiple. Due to medial degeneration. Occasionally cutaneous nævi. Blood-pressure normal.

2. ANGIOMA.

Complicated masses of dilated blood-vessels. Congenital. Commonest in distribution of middle cerebral artery. If calcified, may show in radiographs. Treatment: X rays may be effective; ligature of vessels has little effect.

Venous.—Headache. Jacksonian epilepsy. Facial nævi common. No audible bruit. Papilloedema rare. Hemiplegia if rupture.

Arterial (arteriovenous aneurysm).—Jacksonian epilepsy. No cutaneous nævi but scalp often vascular. Bruit usual. Papilloedema common. Hemiplegia by invasion.

3. ANGIOBLASTOMA.

Solid or cystic mass. Cerebellum commonest. Symptoms as tumour.

SUBARACHNOID HÆMORRHAGE.

Commonly due to congenital aneurysm. Usually about middle age.

Symptoms.—Produced by:—

1. **PRESSURE OF ANEURYSM BEFORE RUPTURE.**—On anterior communicating artery: may press on (a) pituitary; (b) optic chiasma, causing ophthalmoplegia. On posterior communicating artery: may be adherent to and press on third and sixth cranial nerves.

2. **HÆMORRHAGE**, either by leaking or rupture. Result may be:—

i. **APOPLECTIC TYPE.**—Sudden severe hæmorrhage. Symptoms as in cerebral hæmorrhage.

ii. **MENINGITIC TYPE.**—Slow or repeated hæmorrhages or leaking. May cause pressure on: third nerve (always); ophthalmic branch of fifth (pain over eye), also fourth and sixth. Intracranial pressure rises and meningeal irritation is caused: headache, vomiting, confusion, pyrexia, rigidity of neck; delirium, convulsions, coma. May be heavy albuminuria and glycosuria (cause uncertain). Fundi: retinal hæmorrhages, subhyaloid hæmorrhages, and papilloedema (due to subarachnoid hæmorrhage extending into optic sheath).

iii. **LUMBAGO-SCIATICA TYPE** (Hall).—May be pains for several days; meningitic symptoms then develop.

Cerebrospinal Fluid.—(a) Blood present; (b) Does not clot; (c) Yellow supernatant fluid when red cells settle. After few days, fluid yellow; no blood-cells.

Prognosis.—Many cases recover. May be residual headache and mental and motor impairment. Recurrent attacks not uncommon. May be complete recovery, even from coma.

Treatment.—Lumbar puncture, repeated as necessary.

CHAPTER CLXXII.

DISEASES OF THE CEREBELLUM.

Functions of the Cerebellum.—The vermis is connected with both sides of the body. Each lateral lobe is connected with the same side of the body, and diseases thus produce effects on the same side as the lesion. The lateral lobe has an inhibitory action on the opposite cerebral hemisphere by tracts through the superior cerebellar peduncle. The essential function of the cerebellum is *maintenance of muscular tone*. Alterations, irregular activity, and defects in the function produce all the various cerebellar manifestations. Three chief cerebellar defects are described: (1) *Hypotonia*: Lack of muscular tone. (2) *Asthenia*: Fatigability and weakness. (3) *Atasia*: Irregularity of muscular contractions (causing staggering gait, tremors, etc.).

The cerebellum is not an organ of equilibrium, nor does it (grossly) control the labyrinth.

Cerebellar Syndrome.—On same side as lesion.

1. HYPOTONIA.—Flaccidity of muscles.
2. ASTHENIA.—Weakness and fatigability.
3. CEREBELLAR ATAXIA.—(a) Gait reeling and lurching. If lesion unilateral, patient usually bears to affected side: may attempt to compensate this by rotating body to other side. (b) Standing unsteady, patient tends to fall to affected side. Unaffected by opening or closing eyes (no Romberg's sign). (c) Vertigo. Sensation of rotation away from side of lesion (cf. cerebello-pontine tumours).
4. NYSTAGMUS.—Rarely absent. Quick coarse jerk towards point watched, with slow movement away, most marked on looking towards side of lesion.
5. DISORDERS OF MOVEMENT.—(a) Inco-ordination, difficulty in performing and controlling range of movements (including speech). Partly due to hypotonic state of antagonistic muscles. (b) Dysdiadochokinesis: repeated movements more slowly and clumsily performed on affected side (e.g., rapid supination and pronation of wrist). (c) 'Rebound phenomenon.' (d) Associated movements in homolateral limb on strong muscular efforts by affected limb.
5. TREMORS AND CHOREIFORM MOVEMENTS.—Spasms or rhythmical movements of unsupported parts. Head, trunk, or limbs.
6. ATTITUDE.—Occiput towards affected shoulder (not solely cerebellar; occurs also in interference with labyrinth).
7. BĀRÁNY'S POINTING TEST.—Outstretched arm deviates ('points past') towards affected side.
- 'SKEW DEVIATION' OF EYES.—Rare. For few days after a lesion.
- REFLEXES.—Knee-jerks may be diminished or choreic. Plantar response flexor.
- SENSATION, SPHINCTERS, MENTAL CONDITION.—Unaffected.

I. TUMOURS OF THE CEREBELLUM.

Occur both in children and adults. Glioma, tubercle, endothelioma commonest. (See INTRACRANIAL TUMOURS, p. 1013.)

Symptoms.—(A) *General*; (B) *Cerebellar*; (C) *Pressure effects by extension*.

A. GENERAL SYMPTOMS.—Early and severe; headache (often occipital), vomiting, and optic neuritis.

B. SPECIAL CEREBELLAR SYMPTOMS.—See CEREBELLAR SYNDROME, p. 1038. In chronic tumours, other portions of the brain may take over the cerebellar functions, and the special symptoms become slight or absent.

C. PRESSURE EFFECTS BY EXTENSION.—Not usually marked.

CRANIAL NERVES.—Rare except 6th (common).

PONS.—Spastic hemiplegia on opposite side, from pressure on pyramidal tracts.

'FORCED ROTATORY MOVEMENTS'.—Occasionally when 5th nerve affected (through middle cerebellar peduncle), body tends to rotate, usually *away from lesion*.

Diagnosis from tumours of cerebello-pontine angle, and general diagnosis.—See INTRACRANIAL TUMOURS.

Prognosis and Treatment.—See INTRACRANIAL TUMOURS.

II. VASCULAR LESIONS OF THE CEREBELLUM.

Thrombosis of Posterior Inferior Cerebellar Artery.—Produces complex but characteristic group of symptoms, due to distribution to portion of cerebellum and medulla.

ONSET.—Rapid, without loss of consciousness.

ON SIDE OF LESION.—(1) Ataxia of limbs. (2) Anæsthesia of face and pharynx (descending root of 5th nerve). (3) Paralysis of palate affecting swallowing, and of vocal cords affecting speech (nucleus ambiguus and vago-glossopharyngeal nucleus). May be: (4) Nystagmus to side of lesion; (5) Loss of taste.

ON OPPOSITE SIDE.—Anæsthesia of trunk, limbs, and sometimes face: to pain, heat, and cold, while light touch and muscular sense often escape (dissociated anæsthesia).

Occasionally: sympathetic nerve disturbance on side of lesion, viz., pupil small, palpebral fissure narrowed; tachycardia.

Transient affection of 6th, 7th, and 8th nerves on side of lesion may occur: tinnitus and Ménière's symptom-complex, etc.

Cerebellar Hæmorrhage.—Rare. Symptoms indefinite. Usually superior cerebellar artery. Pain at back of head, repeated vomiting, followed by unconsciousness. May be rotation to side of lesion, skew deviation of eyes. If recovery, cerebellar syndrome present. Often fatal from rupture into 4th ventricle.

III. PRIMARY DEGENERATION OF THE CEREBELLUM.

A group of rare diseases.

Primary Progressive Degeneration.—A familial disease. *Onset* at age about 30 to 40 years. Progresses to death. *Symptoms* of cerebellar syndrome: most marked are: (1) Reeling gait and disturbance of equilibrium. (2) Tremors of head and limbs, and inco-ordinate movements. (3) Articulation: hesitating, scanning, or explosive. (4) Nystagmus or irregular nystagmoid movements. Sensation, sphincters, pupils, and eye movements normal. No mental impairment.

Morbid Anatomy.—Primary degeneration of cerebellar cortex, with atrophy of cells of Purkinje and fibres to central nuclei of cerebellum. Afferent and efferent cerebellar tracts unaffected.

Olivo-ponto-cerebellar Atrophy (Thomas).—No familial or hereditary factors. *Onset* in late life. Progresses slowly to death. *Symptoms* of cerebellar syndrome: most marked are: (1) Reeling gait and disturbance of equilibrium. (2) Tremors of limbs. (3) Articulation slow and scanning. May be nystagmus.

Morbid Anatomy (Thomas).—Atrophy of cerebellar cortex, bulbar olives, and gray matter of pons. Total degeneration of middle cerebellar peduncles. Partial degeneration of restiform bodies. Central nuclei of cerebellum but slightly affected.

Other varieties differentiated, all rare, include: sporadic forms resembling primary progressive degeneration, and due to interstitial changes; acute cerebellar palsies in children, with or without encephalitis (*see* PALSIES OF CHILDREN, p. 1023); spino-cerebellar ataxia, closely allied to Friedreich's ataxia (*see* p. 954).

CHAPTER CLXXIII.

DISEASES OF THE MENINGES.

I. PACHYMENINGITIS.

(Disease of the *Dura Mater*.)

Varieties.—May be either of the outer or inner layer, respectively pachymeningitis externa and interna.

PACHYMENINGITIS EXTERNA.—

CEREBRAL.—Results from: (1) Fracture of skull and subsequent hæmorrhage. (2) Inflammation—rare: by extension from neighbouring tissues, e.g., syphilitic caries, middle-ear disease. *Symptoms*: indefinite; of compression, or masked by causal condition.

SPINAL.—(1) Chronic: not uncommon, from tuberculous caries of bone. (2) Acute: rare, from aneurysm, syphilitic caries, tumours. *Symptoms*: from implication of roots and pressure on cord.

PACHYMEINGITIS INTERNA.—(1) *Purulent*: by extension from pia; very rare. (2) *Hæmorrhagic*: may be: (a) Cerebral, viz., pachymeningitis (interna) hæmorrhagica; (b) Spinal, usually mainly in cervical region, viz., pachymeningitis cervicalis hypertrophica.

(**Hæmorrhagic Pachymeningitis** (*Hæmatoma of the Dura Mater*).—

CEREBRAL FORM.—Very rare except in old people with dementia of various types, e.g., dementia paralytica: very rarely in cachexia, or severe anæmia at other ages. All conditions are associated with wasting of convolutions.

MORBID ANATOMY.—May be: (1) Thin subdural membrane; (2) Subdural hæmorrhage; or (3) Both. Virchow considered initial lesion inflammatory, the membrane forming first and the hæmorrhage being secondary. Authorities not yet unanimous; some still believe the membrane to be result of clotting of hæmorrhage.

SYMPTOMS.—Absent or indefinite, e.g., headache, delirium, stupor, convulsions, etc.

SPINAL FORM.—Rarer than above: may coexist with it and symptoms be masked, or symptoms as in type following.

Hypertrophic Pachymeningitis of the Cord.—Usually in cervical region (*pachymeningitis cervicalis hypertrophica*). Rarely in lumbar zone. This special type is probably a fibrosis and not hæmorrhagic.

ETIOLOGY.—Syphilis in some cases. Often no factor.

MORBID ANATOMY.—Great thickening of the dura mater, embedding and compressing nerve roots and cord. May involve one or more segments.

SYMPTOMS.—Due to involvement of anterior and posterior roots and compression of cord. (1) *Root pains* intense and bilateral: mainly arms and neck. Areas of hyperæsthesia and anæsthesia. Followed after few months by: (2) *Wasting and atrophy* in upper limbs, commencing in hand, with contractures and 'claw-hand'. (3) *Spasmodic paraplegia* in lower limbs. Disturbance of sensation and sphincters.

COURSE.—Chronic: a few years.

DIAGNOSIS from: (1) Tumours of meninges: onset in tumours unilateral, progress more rapid; in later stages symptoms identical. (2) Syringomyelia: by absence of the special sensory changes. (3) Caries: tubercle very rarely produces similar symptoms without obvious disease of bone; root symptoms less marked. (4) Amyotrophic lateral sclerosis: by sensory changes and severity of pains in pachymeningitis.

TREATMENT.—Antisyphilitic or palliative.

II. MENINGITIS.

Leptomeningitis, disease of the pia mater, commonly referred to as 'meningitis', occurs in various clinical, bacteriological, and etiological types:—

1. Tuberculous meningitis.
2. Cerebrospinal meningitis.

Meningitis—Types, *continued*.

3. Suppurative or septic meningitis.
4. Pneumococcal meningitis.
5. In various acute infections and specific fevers : rare. Most common : enteric, influenza. Occasionally : gonorrhœa, scarlet fever, mumps, etc.
6. Syphilitic meningitis. (Course chronic or subacute.)
7. Terminal infection in debilitating diseases : cancer, chronic nephritis, etc.

Also :—

8. Meningism.

9. Quincke's serous meningitis. (*See* p. 1024.)

A summary of the general symptoms of meningitis is given under suppurative meningitis (*below*). For tuberculous, acute cerebrospinal, and syphilitic meningitis, see the respective sections.

Suppurative or Septic Meningitis.—Secondary to : (a) Local disease, e.g., middle-ear disease, cerebral abscess, disease of cranial bones ; (b) General or distant infections, e.g., general septicæmia, acute osteomyelitis.

MORBID ANATOMY.—Thick greenish exudation either at vertex or base, and often extending into cord, or may be maximum at point of origin. Brain tissue hyperæmic. Ventricles usually distended.

SYMPTOMS.—The chief symptoms of meningitis are :—

1. HEADACHE.—Severe and rarely absent.
2. VOMITING.—Of cerebral type (frequent ; no retching or pain ; independent of food).
3. PYREXIA.
4. PULSE.—Slow and irregular.
5. RESPIRATION.—Slow and irregular.
6. PUPILS.—Frequently unequal. Early stages, contracted ; later, dilated.
7. STRABISMUS.
8. OPTIC NEURITIS.—Commonest in basal meningitis, but often absent.
9. CONSTIPATION.

Various.—*Rigidity of neck*, if cord involved. Cranial nerve affections in basal meningitis. Spasms of muscles when cortex irritated. Kernig's and Brudzinski's signs. Reflexes may be increased early, later absent : may be extensor plantar reflex (Babinski's sign).

Blood.—Leucocytosis often marked : may be absent.

Cerebrospinal fluid.—Under pressure. Protein present. May be cloudy. Polynuclear cells numerous. May be organisms present in films or on culture.

Later stages :—

RESTLESSNESS.—Irritability. Teeth-grinding common.

PULSE.—Rapid and feeble. Temperature variable.

RESPIRATION.—Often Cheyne-Stokes type.

DELIRIUM.—Passing into terminal coma.

DURATION.—A few days.

Pneumococcic Meningitis.—

ETIOLOGY. (1) Primary: either alone or with pneumococcic septicaemia. (2) Secondary: (a) local disease, e.g., otitis media, (b) distant infections, e.g., empyema, pericarditis.

MORBID ANATOMY.—Exudation markedly thick and profuse, either at vertex or base. Cord rarely escapes.

SYMPTOMS.—*See* SUPPURATIVE MENINGITIS. Onset usually very rapid, and duration short (1 to 3 days). Invariably fatal.

Note.—‘Meningism’ is common in acute pneumonia.

Enteric Fever: Influenza.—Symptoms of meningitis may be due to: (a) Meningism, commonly. (b) True meningitis, very rarely; either (i) specific organism, or (ii) pyogenic organism.

Recovery may occur.

Meningism.—During acute specific fevers a condition may occur in which symptoms resemble, or are identical with, meningitis, but in which recovery occurs, or at autopsy no changes of meningitis are present. Especially common in enteric fever, also in acute pneumonia: occasionally occurs in middle-ear disease, and alcoholism.

DIAGNOSIS FROM MENINGITIS.—Suggestive of meningism are: (1) Onset early in disease; (2) Onset rapid; (3) Slow pulse and respiration less frequent; (4) Kernig’s sign usually absent; (5) Cranial nerves rarely affected, except strabismus; (6) Cerebro-spinal fluid: no changes of meningitis, but may be increased pressure.

CHAPTER CLXXIV.

GENERAL DISEASES WITHOUT
RECOGNIZED ANATOMICAL BASIS.

I. PARALYSIS AGITANS.

(*Parkinson’s Disease. Shaking Palsy.*)

A chronic disease of later life, characterized by peculiar tremors, rigidity, attitude, expression, and gait. Not uncommon.

Etiology.—

AGE.—Usually 50 to 60 years. Rare under 40.

SEX.—Males twice as common as females.

HEREDITY.—Instances rare.

EXCITING CAUSES.—Ascribed to mental worries, or exposure to wet or cold. Occasionally sudden onset following such stimuli. Syphilis and alcohol: no influence. Closely similar condition, often developing rapidly, common in encephalitis lethargica.

Morbid Anatomy.—No constant changes. In nervous system, especially cord, may be thickening of small vessels and overgrowth of neuroglia connective tissue, as in senility, but not invariable. Clinically, points to changes in cerebral cortex. S. A. Kinnier Wilson suggests corpus striatum, from certain resemblances to progressive lenticular degeneration.

Paralysis Agitans, *continued*.

Symptoms.—

ONSET.—Gradual. Very rarely, rapid. *Tremors* usual initial symptom; commence in one hand, then same leg (unilateral paralysis agitans), later on other side, and general symptoms. Aching and stiffness may precede tremor.

STAGE OF INVASION.—I to 3 years.

CLINICAL CONDITION FULLY DEVELOPED.—Characteristics :

(1) *Tremors*; (2) *Rigidity*; (3) *Attitude*; (4) *Facies*; (5) *Gait*.

TREMORS.—Typically in hands. General character of movements: Regular and rhythmical; at first fine, rate 5 to 7 per second; later coarser and slower. *Increased by rest and emotion*. Checked temporarily by will or voluntary movement. Cease in sleep.

Hands: 'Pill-rolling' movements of fingers, with pronation and supination of forearm, occasionally some flexion and extension of wrist. *Position of fingers*: metacarpophalangeal joints flexed with phalangeal joints extended ('interosseal position') or flexed: thumb opposed to index finger. Large joints of arm rarely affected.

Legs: Ankle-joints most commonly affected.

Head: Not often affected; occasionally to-and-fro movements. Face very rare: eyes never.

RIGIDITY.—Progressive: cause of attitude, expression, and gait.

Muscular weakness progressive, but no absolute paralysis.

Voluntary movements all slow and deliberate.

ATTITUDE.—Characteristic. Stands with head bent forward, back curved and rigid; arms flexed at elbows, held away from body; hands in front of abdomen.

FACIES.—'Parkinson's mask'. Expressionless and changeless. Eyebrows often elevated, forehead smooth or wrinkled.

GAIT.—A hurried shuffle, "running after the centre of gravity" ('*festinant*' or propulsion gait). Starts slowly, and has difficulty in stopping. If pulled backwards, makes several rapid steps and tends to fall ('retropulsion'). Attitude, as described, continues on walking and is cause of gait.

Gait may be normal for several years after tremors.

VOICE.—Often shrill and monotonous. Hesitation followed by rapid speech.

SENSORY DISTURBANCES.—(1) Sensation of great heat common. May be sweating and local rise of temperature. (2) Cramps and aches common. Often severe in later stages, causing restlessness. Cutaneous sensation normal.

SKIN.—Sometimes thickened.

MENTAL CONDITION.—Unchanged.

Sphincters unaffected. *Reflexes* normal, or increased.

Course and Prognosis.—Incurable. Gradual advance, with periods of improvement. Becomes bedridden. Death from pneumonia or other intercurrent disease.

DURATION.—8 to 10 years. Rarely 20 to 30 years.

Diagnosis.—Usually at sight. Difficulty in atypical cases, or in absence of a characteristic symptom, e.g.: (1) *Tremors absent*, other signs often well marked; (2) Tremor alone; (3) Unilateral distribution. Generally these cases are in an early stage, and completer syndrome develops later. Diagnosis also from:—

SENILE TREMORS.—Face muscles early affected.

OSTEO-ARTHRITIS.—Thickening or grating of joints.

Treatment.—Does not cure, but alleviates suffering. *Indications:* to maintain strength and diminish tremors and rigidity.

GENERAL.—Quiet life. Massage, active and passive movements, warm baths: inhibit rigidity and aid nutrition. In later stages, comfortable bed and light bed-clothing.

DRUGS.—Hyoscine hydrobromide. Either: (1) Hypodermically, gr. $\frac{1}{100}$ to $\frac{1}{80}$ at night; or (2) By mouth, gr. $\frac{1}{150}$ increasing to gr. $\frac{3}{80}$ night and morning. Considerable relief. Beware of toxic action Tinct. stramonii, ℥ 5 to 20, t d s. For sleeplessness, barbitone. For aching pains, aspirin or salicylates

II. CHOREA.

(Sydenham's Chorea. St. Vitus' Dance.)

A disease mainly of childhood, characterized by irregular involuntary muscular spasms, and by frequent occurrence of endocarditis. It is closely connected with acute rheumatism.

Etiology.—

AGE.—Usually between 5 and 15 years. Rare under 5 and over 20 years, except in pregnancy.

SEX.—Females form 70 per cent. Over 20 years nearly all females.

INHERITANCE.—(a) Rheumatic family history 15 to 20 per cent;

(b) Nervous family common. Red hair frequent in chorea.

RELATION TO ACUTE RHEUMATISM.—Close relationship of chorea shown by:—

1. Frequency of acute rheumatic arthritis either (a) previously, or (b) immediately before chorea.
2. Frequency of acute endocarditis; also of pericarditis.
3. Other symptoms occurring in both, e.g., tonsillitis, subcutaneous nodules.

RELATION TO MENTAL DISTURBANCE.—Close. Usually clever children. *Sudden strain*, e.g., fright: chorea may be immediate or after few days. *Chronic strain*: overwork at school of special importance. A group, very resistant to treatment, occurs in subjects intellectually below normal.

RELATION TO PREGNANCY.—Not infrequent, especially if emotion great. Characteristics: (1) First pregnancy most common. (2) Onset about 3rd month. (3) Often severe, may be maniacal; considerable mortality. (4) May recur in successive pregnancies. (5) Rarely, after abortion or full time.

OTHER ETIOLOGICAL FACTORS OF LESS IMPORTANCE.—*Acute Infectious Fevers.*—No relation except to scarlet fever with arthritis.

Imitation.—Never a cause.

Chorea—Etiology—Factors of Less Importance, *continued*.

Hysteria.—May simulate chorea ; and is one cause of 'epidemics of chorea'.

Reflexes.—Irritation by worms, adenoids, ocular defects : n relation beyond effect on health.

Morbid Anatomy.—Acute endocarditis in 90 per cent of fatal cases. Site and nature of specific lesion obscure. Choreiform movements experimentally produced by lesions of superior cerebellar peduncles, optic thalamus, caudate nucleus, and red nucleus, but no proof of presence in chorea.

Poynton, Holmes, and Paine described small cortical lesions with presence of rheumatic diplococci (encephalitis).

Kirkes' Theory.—Multiple minute cerebral emboli from endocarditis. Unproved.

PATHOGENESIS.—Two predominating factors, often coexistent ; (1) Acute rheumatic manifestations ; (2) Mental overstrain, acute, chronic, or inherited.

Symptoms.—

GENERAL DESCRIPTION OF MOVEMENTS.—Irregular, involuntary, purposeless, spasmodic movements.

IRREGULAR.—Same movement is not repeated, as it is in tics.

INVOLUNTARY, but, with mental effort, movements can be inhibited temporarily and a voluntary movement performed.

PURPOSELESS, but muscles contract in sequence as in performing a voluntary movement ; differing from the contraction of a single muscle, e.g., platysma myoides, as in certain nervous conditions.

SPASMODIC.—Movements sudden and of short duration.

DURING SLEEP.—Movements usually cease.

All possible movements, voluntary and of expression, may occur, and in all grades of severity.

Other factors are : (1) *Paresis*, some degree invariable ; (2) inco-ordination ; (3) Hypotonus. Assessment and separation of these factors in given case usually impossible.

DISTRIBUTION OF MOVEMENTS.—Frequency : (1) Hands or face ; (2) Legs ; (3) General. *Hemichorea* common, especially right, but bilateral in face. Slight movements well exhibited on extending arms with fingers widespread and simultaneous protrusion of tongue.

MODES ON ONSET.—(1) Movements rapidly develop. (2) Dropping of articles. (3) Dragging one leg. (4) Changes in temperament ; dullness or irritability.

CLINICAL CONDITION DEVELOPED.—

MOVEMENTS.—As described. Facial expressions, eyebrows, tongue, jerks of head ; movements of fingers, hands, shoulders, upper extremities ; legs ; trunk. *Respiration* : often affected, e.g., sudden spasmodic inspiration. *Mastication and deglutition* : difficult in severe cases.

SPEECH.—Often impaired, jerky. *Aphasia* : occasionally complete for weeks in severe cases : never permanent.

CARDIAC SYMPTOMS AND DISEASE.—Rarely cardiac pain or complaints. Heart rapid. Apex beat often diffuse. Haemic murmurs (base or less often apex) not uncommon. No dilatation, or displacement of apex beat.

ORGANIC HEART DISEASE.—Very frequent. *Note*: (1) Present at onset from previous rheumatism (history often absent); or (2) Develops during chorea or afterwards: occurs in 50 per cent at least. (3) Becomes commoner with each recurrence. (4) *Acute endocarditis* usual form: generally mitral valve, stenosis frequent. Present in 90 per cent of fatal cases. Ulceration rare. Embolism rare. (5) *Pericarditis* common.

TEMPERATURE.—In severe cases rarely absent, but slight and of short duration. Continued pyrexia suggests endocarditis or arthritis. Hyperpyrexia, usually with pericarditis or delirium.

REFLEXES.—No constant change. *Knee-jerk*: response often delayed and then contraction 'sustained'. May be due to (a) increased reflex, or probably (b) a choreic movement or pseudo-reflex.

PARESIS.—Usually slight. Rarely, severe (movements often slight); flaccid type; never permanent ('paralytic chorea').

MENTAL DISTURBANCES.—Common but slight: dullness or irritability. Rarely mania; and then usually in adult females and pregnancy ('chorea insanienis').

SCURTANEOUS NODULES.—On fibrous structures: especially palpable at point of elbows and wrists; usually multiple, rarely larger than pea. *Presence serious*: confine to bed while present: pericarditis often occurs.

ANÆMIA develops in later stages.

Of less importance: *Sensory symptoms*; pain very rare. No changes in sensation. *Sphincters* unaffected. *Electrical reactions*: normal. *Pupils* usually dilated: hippus may occur. *Skin*: occasionally various 'rheumatic' eruptions, e.g., erythemata, purpura. *Urine*: urea excretion high.

Varieties.—Certain special types: (1) Hemichorea; (2) Paralytic chorea; (3) Chorea of pregnancy; (4) Chorea insanienis; (5) Chorea gravis—movements of great severity.

Course and Prognosis.—

DURATION.—Variable. Movements rarely exceed two months. Relapses common.

RECOVERY from immediate attack: usually complete: when severe, slight movements may persist, increased on excitement.

RECURRENCES.—Frequent, especially in spring.

MORTALITY.—About 2 per cent.

TEST OF SEVERITY OF ATTACK.—Consider: (1) Extent of involuntary movements. (2) Extent of performance of voluntary movements. (3) Affection of speech. (4) Dangerous symptoms and conditions, as below.

Chorea—Course and Prognosis, *continued*.

DANGEROUS SYMPTOMS AND CONDITIONS.—

1. Acute endocarditis. Affects remote more than immediate prognosis. Embolism rare.
2. Pericarditis. Subcutaneous nodules often precede onset.
3. Hyperpyrexia. Pericarditis frequently present. Prognosis serious.
4. Chorea of pregnancy. Often severe.
5. Chorea insaniens, and severe psychical disturbance. Most frequent in last group.
6. Chorea gravis. Exhaustion may be fatal.

Diagnosis.—Usually simple. Main difficulties:—

HYSTERIA.—Movements purposeful, usually repeated. Worse on order to control.

TICS AND HABIT SPASMS.—Repetition of similar movement. In rare maniacal and paralytic choreas, movements occasionally overlooked.

Difficulties rarely occur with other tremors, e.g., athetosis, Friedreich's ataxia, and sequelæ of encephalitis lethargica.

Treatment.—Two essentials: (1) Complete rest; (2) Full diet.

REST.—Complete rest in bed, for body and brain, i.e., no books or games. At least four weeks, and until movements completely subside.

DIET.—Commence with milk (5 pints), cream, eggs, and bread and butter. Full diet in few days with extra milk and cream, or in milder cases from onset.

DRUGS.—Little value, and action on spasms slight. In most use are:—

ASPIRIN gr. xl to lx, daily. (Calcium aspirin is more soluble.) Especially if rheumatism. Salicylate of sodium similarly, but less valuable.

ARSENIC.—Good tonic: no proved effect on spasms. Fowler's solution, ℥ij, t.d.s.; increase ℥j, alternate days, to ℥xv, well diluted and after food. Watch for signs of excess, and if occurring remit for one week.

SEDATIVES.—Chloral and sod. bromide, āā gr. v to x, t.d.s., or chlorotone. Diminish spasms, but *subsequent mental derangement not infrequent*, especially in severe cases, less often in milder types, but sedatives here unnecessary. Spasms often return on remitting drug. Hence use only in severe cases where other measures fail. Remit if cardiac weakness occurs. *Nirvanol*: dose 0·1 gm. for few days until temperature rises; jaundice and serious toxic results not uncommon. Sedatives must not be employed as a routine treatment.

SEVERE TYPES.—Water bed. Wet packs (either cold or tepid). Stimulants. Sleep often prevented and is essential: obtain rest by: (1) Chloral and bromide, or chlorotone; (2) Chloroform inhalations. Morphia rarely succeeds if chloral fails.

ACUTE ENDOCARDITIS.—*See* ENDOCARDITIS, p. 797.

CONVALESCENCE.—Treatment of great importance.

FRESH AIR. *Moderate exercise.* Long night, and rest on couch part of day.

FULL DIET. Tonics of iron and strychnine. Cod-liver oil or similar preparations.

CORRECT ALL SOURCES OF IRRITATION, viz., ocular defects, adenoids, etc.

WARN PARENTS AGAINST: possibility of recurrences, of heart disease, and of ill-effects of mental worry, *especially examinations.*

III. HUNTINGTON'S CHOREA.

(*Chronic Hereditary Chorea*)

A rare disease characterized by: (1) Choreiform movements; (2) Onset in middle life; (3) Progressive mental weakness; (4) Usually hereditary and familial.

Etiology.—

AGE.—Onset at 30 to 40 years. Both sexes.

HEREDITY.—Has been traced through many generations: transmitted by both sexes. If one generation escapes, does not recur.

Morbid Anatomy.—Lesions in central nervous system, but not pathognomonic: general resemblance to dementia paralytica.

1. **BASAL GANGLIA**—Degeneration of nerve cells. Also in cerebral cortex.
2. **MEMBRANES.**—Chronic pachymeningitis and inflammation of pia-arachnoid.
3. **CHRONIC ENCEPHALITIS.**—Atrophy of convolutions: primary parenchymatous degeneration of neurons.

Symptoms.—

ONSET gradual: movements before mental changes.

MOVEMENTS.—As in chorea, but slower, and *inco-ordination marked*. Commence in hands and face. In early stage controlled by will, and voluntary movement possible. Later severe and universal. Much facial contortion, speech difficult owing to tongue spasms, gait lurching.

MENTAL DISTURBANCE.—Attacks of depression or excitement: may be suicidal: progresses to complete dementia.

Course.—Progressive. Life often not shortened.

Treatment.—Palliative only. Arsenic and tonics.

SENILE CHOREA.

Onset usually after 50 years. Occasionally ascribed to anxiety or fright.

Movements as in chorea. No relation to rheumatism or endocarditis.

Morbid Anatomy.—Resembles Huntington's chorea. Regarded by many authorities as a sporadic form (probably correctly), and course may be identical, but differs in following: mental changes are rarer, recovery may occur, no hereditary or familial factors (brothers, sisters, and children unaffected).

CONGENITAL CHOREA.

Very rare. Movements present from birth and persist. No spasticity. Mentally slow but not idiots. Related to Huntington's chorea.

Note.—*Cerebral diplegias* with choreiform movements show definite spasticity.

IV. MIGRAINE.

(*Hemicrania.*)

A condition characterized by paroxysmal attacks of headache, usually with nausea, and often preceded by disorders of vision.

Etiology.—

AGE.—First attack usually between 5 and 20 years : rarely after 30.

HEREDITY.—Common. Gout and neuroses not infrequent in family. Mental ability often above normal. Rarely in outdoor occupations.

EXCITING CAUSES.—Mental worries ; gastric disturbances ; ocular defects ; fatigue ; menstruation. Often no evident cause.

Pathology.—No gross changes. Theories include :—

1. SPASMS OF CEREBRAL ARTERIES (or dilatation of vessels and cerebral oedema).—Suggested by vasomotor phenomena and recorded spasm of retinal arteries and transient paralyses.
2. PITUITARY SWELLING.
3. Intermittent hydrocephalus of one lateral ventricle.
4. Neurosis.

Pathogenesis.—Probably many types. Fair proportion suffered in youth from cyclical vomiting (sick headaches) ; these cases are related to error of fat metabolism (not steatorrhœa) and possibly hypoglycæmia, and benefit by appropriate treatment : often show less characteristic 'migrainoid' attacks, but may be typical. Others do best on vegetarian diet. Some are akin to allergic group.

Symptoms.—

CHARACTERS OF ATTACK.—Premonitory symptoms common, especially visual, followed by headache and nausea.

PREMONITORY SYMPTOMS.—

1. **VISUAL PHENOMENA.**—Very common. Two forms, often combined : (a) Alterations in vision. Often 'steaminess' of sight, or small central blind spot gradually extending ; may be homonymous hemianopia. (b) Occurrence of colours, usually dull but rarely brilliant. Often commence centrally and spread outwards : in bands or 'fortification figures'. All degrees from specks to formed objects.
2. **SENSORY PHENOMENA.**—Unusual. Tingling in an extremity, spreading slowly to head : usually opposite side to headache. Subsequently slight paresis, or sometimes anæsthesia.
3. **VERTIGO, SLIGHT INCOHERENCE, OR APHASIA.**—Occasionally.

HEADACHE.—Follows premonitory symptoms.

ONSET.—Usually in one spot, temple, eyeball, etc. Extends and increases: usually unilateral, i.e., hemicrania; occasionally pain extends into neck, rarely arm, or both sides of head. Scalp tenderness common. Intensity varies: often extreme. Character boring or throbbing. Increased by movement, noise, light, or erect position.

NAUSEA.—Rarely absent. Anorexia marked. Vomiting occasionally: may be recurrent.

VASOMOTOR PHENOMENA.—Occasionally: sometimes marked. May be unilateral. Face and extremities pale and cold, pupils small; later hyperæmia. Pulse may be slow. Temporal arteries may be in spasm.

VARIATIONS IN ATTACKS.—Headache and nausea without premonitory symptoms common. Less often, marked visual phenomena with slight headache.

DURATION.—Usually one day, ends with night's rest; if severe, subsequent malaise one to two days. In rare cases, may be subsequently a transient aphasia, paresis, or complete blindness.

Course.—Attacks recur for years. Subject often aware of approach of an attack before definite premonitory symptoms. Often monthly or periodically, but frequency varies. In same individual, attacks may resemble each other closely, or may vary greatly. *Cessation* usual about age of 50, or after climacteric: sometimes with removal of exciting cause.

Diagnosis.—

EPILEPSY.—In migraine: (1) Prolonged premonitory symptoms; (2) Visual phenomena; (3) No unconsciousness or spasm; (4) Severity of headache.

CEREBRAL TUMOUR.—In migraine: (1) Long duration; (2) Long intervals of freedom; (3) No optic neuritis; (4) Visual phenomena.

CHRONIC NEPHRITIS.—In migraine: no urinary changes.

Note.—After attack of migraine, much pale urine may be passed.

Treatment.—Subject sometimes learns, and occasionally averts, exciting cause. Blood-sugar should be estimated.

GENERAL HYGIENE.—General healthy life, with outdoor exercise. Also:—

1. Treat any exciting cause, especially ocular and gastric defects.
2. Diet. Vegetarian diet, or reduction of meat, often, but not invariably benefits. Some subjects need meat. Alcohol best omitted.
3. Bowels. Strictly regulated.

FAT METABOLISM.—Always worth trial. Principles: (1) Avoid fat (especially of milk); (2) Food at short intervals (2½ hours); (3) Alkalis; (4) Sugar plentifully.

PREVENTION OF ATTACKS.—Often defies treatment. Try luminal gr. ½, b.d. or t.d.s.

TREATMENT OF ATTACK.—Rest in a quiet dark room. Warmth to feet. Hot drink. No alcohol. At earliest warning, a saline

Migraine—Treatment, continued.

purge and calomel. *Local*: cold compresses to head. *Drugs* vary with subject: aspirin gr. x to xxx, or phenacetin gr. viij with caffeine gr. ij, or pyramidon gr. vij to x. Ergotamine tartrate: often successful. Femergin tablets contain 1 mgm. (also solution for injection. (Most subjects prefer to be undisturbed.) Tonic after the attack.

V. NEURALGIA.

Paroxysmal pain in course of a nerve in absence of organic disease of the nervous system. This definition excludes neuritis. The pain and symptoms may be identical with, and the distinction difficult from, conditions with an organic basis. Visceral referred pains are not true neuralgia.

Etiology.—

AGE.—Usually middle life.

SEX.—Commoner in women.

PREDISPOSING CAUSES.—(1) *Neurotic taint*; (2) *Anæmia and debility* of all forms; (3) Influenza, enteric fever; (4) Gout, alcohol, lead poisoning, diabetes, malaria (this group is probably neuritis). May be good health.

EXCITING CAUSES.—Cold, constipation, worry, peripheral irritation.

Symptoms.—

PAIN.—General characters:—

PAROXYSMS every few seconds to minutes; burning or shooting. Between paroxysms: dull ache or painless.

DISTRIBUTION.—Unilateral. In course of a nerve, nerves, or division of nerves: but may spread widely in height of paroxysm.

'TENDER SPOTS'.—Tenderness mainly at certain spots in course of nerve: usually at emergence through fasciæ or bone.

RECURRENCES usual.

VASOMOTOR AND TROPHIC CHANGES.—Occasional. Skin during paroxysm cold, and later hot (often feels numb). Rarely, erythema or œdema over area: when chronic, hairs may whiten and fall out.

Diagnosis.—

ORGANIC DISEASE of nervous system or viscera to be excluded.

NEURALGIA.—Usually: (1) Unilateral; (2) Intermittent; (3) Tenderness mainly at certain tender spots; (4) No muscular wasting; (5) No anæsthesia.

REFERRED PAIN OF VISCERAL DISEASE.—Pain and superficial tenderness in areas not of peripheral nerve distribution.

NEURITIS.—(1) Pain more continuous; (2) Whole course of nerve tender; (3) Muscular wasting. Diagnosis may need long observation.

Treatment.—

INITIAL.—Treat any peripheral irritation. Reassure patient of absence of organic disease.

LOCAL TREATMENT.—Mainly counter-irritation.

1. **HEAT OR COLD.**—Hot bottle or poultice.
2. **SEDATIVE APPLICATIONS.**—(i) Menthol. (ii) Liniment of aconite, belladonna, and chloroform ('A.B.C.'). (iii) Freeze tender spots with ethyl chloride.
3. **COUNTER-IRRITATION.**—Mustard. Blisters (liq. epispasticus). Caution. Leeches. Electricity.
4. **INJECTIONS OF ALCOHOL INTO NERVE TRUNK.**

GENERAL TREATMENT.—Treatment of predisposing causes: tonics, cod-liver oil. Diet plain; meat in moderation only. Regulate bowels. Regular exercise. Massage. Change of air. Alcohol often effective, but needs care.

SPECIAL ANALGESIC DRUGS.—Tincture of gelsemium (Mx, t.d.s.). Butyl chloral hydrate (gr. xxx to l, daily). These two particularly in head neuralgia. Note that butyl chloral is incompatible with alcohol: can be combined with gelsemine hydrochloride gr. $\frac{1}{10}$, t.d.s. Pyramidon (gr. vij to x, t.d.s.), phenacetin, aspirin. Any of these often effective. Also quinine. Morphia and cocaine to be avoided. (*See also* FIBROSITIS, p. 1088.)

SPECIAL CLINICAL VARIETIES.

Neuralgia of Fifth Nerve and Allied Conditions.—*See* TRIGEMINAL NEURALGIA, p. 998.

Cervico-occipital Neuralgia.—

NERVES INVOLVED.—Posterior branches of cervical 1 to 4. Often bilateral.

PAIN.—Back of head and neck, especially along great occipital.

TENDER SPOTS.—Midway between spine and mastoid processes.

SCALP.—Extreme hyperæsthesia common.

ETIOLOGY.—Cold. Also in cervical caries.

SPECIAL TREATMENT.—Division of nerves.

Brachial Neuralgia.—

NERVES INVOLVED.—Branches of brachial plexus.

PAIN.—Shoulder, axilla, along inner arm (ulnar nerve) to fingers.

TENDER SPOTS.—Behind elbow (ulnar). Axilla. Posterior border of deltoid (circumflex).

ETIOLOGY.—Ordinary causes, but injury common and cold rare. Increased by movement. Closely related to brachial neuritis and arthritis of shoulder-joint.

Intercostal Neuralgia.—

NERVES INVOLVED.—Anterior branches of dorsal nerves 2 to 9. Common.

PAIN.—Constant ache, with paroxysms. Increased by respiration.

TENDER SPOTS.—At three cutaneous branches, viz., near spine, mid-axilla, near sternum.

SUPERFICIAL TENDERNESS.—Often severe.

ETIOLOGY.—Common in: (1) Women, especially with hysteria; (2) Herpes zoster, before and after eruption.

DIAGNOSIS.—From (1) Spinal disease: tabes, caries, aneurysm, tumour. (2) Callus of fractured ribs. (3) Angina pectoris. Also (4) Acute lung conditions.

TREATMENT.—Counter-irritation, blisters. Prognosis good.

Neuralgia—Clinical Varieties, *continued*.

Mastodynia (*Neuralgia of Breast*).—

NERVES INVOLVED.—Intercostals supplying breast (2 to 6).
Usually on left.

ETIOLOGY.—Women, middle-age. Debility, pregnancy, over-lactation.

SPECIAL TREATMENT.—Ascertain, and assure patient of, absence of neoplasm.

Lumbar Neuralgia.—

NERVES INVOLVED.—Lumbar plexus.

TENDER SPOTS AND PAIN.—Commonest: iliac crest, scrotum, labium majus. Occasionally: 'irritable testis', spermatic cord, inguinal canal.

LOCAL CAUSES.—Constipation, pelvic disease.

'CRURAL NEURALGIA'.—Mainly front of thigh (anterior crural).
Colon disease, sciatica.

Coccygodynia.—

NERVES INVOLVED.—Coccygeal plexus.

ETIOLOGY.—In women: hysteria, after labour, etc.

PAIN.—Severe and obstinate. Increased by sitting.

SPECIAL TREATMENT.—Removal of coccyx: not always successful.

Metatarsalgia (*Morton's Disease*).—

PAIN.—In 4th metatarso-phalangeal articulation, may extend up leg. Unilateral.

ETIOLOGY.—Usually women. Morton's explanation: head of 5th metatarsal squeezed under 4th and pinches metatarsal nerve (doubtful).

DIAGNOSIS.—From acute rheumatism.

SPECIAL TREATMENT.—Avoid tight shoes; treat flat-foot.
Finally, excision of head of 4th metatarsal.

Other Neuralgias of Feet.—Often from flat-foot.

PAINFUL HEEL.—Often, not invariably, gonorrhoea.

PLANTAR NEURALGIA (e.g., tender toes in enteric).—Often neuritis.

Visceral Neuralgia.—See NERVOUS DYSPEPSIA, p. 415; also HYSTERIA; NEURASTHENIA.

VI. OCCUPATION NEUROSES.

Inability to perform, and usually pain on attempting, some professional muscular action: following its frequent repetition over a considerable period, and without organic disease. Occupations affected are complex acts, carefully learnt, but by repetition becoming practically automatic. Disability applies solely to the special act, and the muscles can be used freely in other groupings and actions.

Nomenclature.—The term 'cramp' is applied to the various conditions, but spasm is often absent, and hence affection is usually considered a true neurosis, a disturbance of the nerve centres. 'Writer's cramp' is the typical and commonest form.

Writer's Cramp.—

ETIOLOGY.—Age 20 to 45 years. Both sexes liable, but males predominate.

PREDISPOSING CAUSES.—(1) *Overwork*, common; (2) *Faulty position* in writing. Occasionally (3) *Slight injury*; (4) *Nervous disposition*.

FAULTY OR STRAINED POSITIONS.—Specially affects those writing with wrist or little finger as fixed position. Correctly, the fingers should be used only to hold pen, and that lightly, and practically all movements made from wrist or forearm, forearm resting on table.

SYMPTOMS.—Commonest form is inability to keep index finger on pen. Complaints may be: (1) *Pain*. 'Neuralgic type'. (2) *Weakness*. 'Paralytic type'. (3) *Spasms*. 'Spastic type'; uncommon; spasm may throw pen from hand. Distinction of types unimportant: pain and weakness often inseparable.

ONSET.—Gradual. First at end of long day and in fingers only. Later, immediately on writing. If persisted in, spreads to forearm and even shoulder.

TENDERNESS over nerve trunks in severe cases. May be local oedema.

SENSATION AND ELECTRICAL REACTIONS normal. **WASTING** rare and slight.

COURSE AND PROGNOSIS.—Always increases if action continued. Prognosis best in mild forms, of short duration, and after injury. Prognosis bad with: (1) *Neurotic taint*; (2) *Long duration*; (3) *Faulty position*. Long rest may cure, but relapse common.

DIAGNOSIS.—Many diseases disturb writing, and examination must be fully made for:—

1. **ORGANIC DISEASE OF NERVOUS SYSTEM.**—As dementia paralytica, hemiplegia, disseminated sclerosis, etc.; also paralysis agitans. Dystrophies, myelopathies, cervical rib and lesions of brachial plexus and its branches, syringomyelia.

2. **LOCAL DISEASE.**—As osteo-arthritis, tenosynovitis, neuritis. Also examine: (1) For neuroses in patient and family. (2) Action of writing: of essential importance. 'Phobia' of writer's cramp not uncommon.

TREATMENT.—

Rest from the action: immediate and complete. If mild, three months. Holiday preferable.

SEVERE CASES.—Rest nine months. Tonics. Massage and gentle exercises for hands (after pains subsided).

RE-EDUCATION of method of writing from commencement, i.e., copy-books. Operations useless.

IF RECURRENCE.—Write with left hand, or use typewriter.

Other Varieties of Occupation Neuroses.—Numerous. General facts and treatment as in WRITER'S CRAMP.

'**PIANIST'S CRAMP**'.—Not uncommon.

'**TELEGRAPHIST'S CRAMP**'.—Very rare.

'**TYPEWRITER'S CRAMP**'.—Excessively rare.

VII. EPILEPSY.

A disorder of the nervous system characterized by repeated attacks of loss of consciousness, often associated with convulsions. Two principal types: (1) *Grand mal* or major epilepsy: unconsciousness with convulsions. (2) *Petit mal* or minor epilepsy: unconsciousness without convulsions. Also Jacksonian epilepsy, in cortical lesions: convulsions without unconsciousness; this type and certain epileptiform convulsions are etiologically distinct from true epilepsy.

Etiology.—

AGE.—Onset commonest under 5 years: 75 per cent before 20 years. No age quite immune, but onset of true epilepsy rare after 30 years. Onset common in infancy, puberty, and second dentition.

SEX.—Equal in childhood. In later decades males in excess. Frequency of attacks increased at menstruation, especially when irregular. Menopause and pregnancy, no influence.

SPECIAL FACTORS.—

1. **HEREDITY.**—Direct inheritance not infrequent (statistics vary). Also epilepsy, insanity, and neuroses common in family history, direct or collateral.

2. **REFLEX IRRITATION.**—Often coincidences, but, in some, removal stops the fits. Most definite is *worms*; less so teething, adhesions of prepuce. Eyes, ears, nose, digestior genitals often suggestive.

3. **PSYCHICAL CONDITIONS.**—Fright.

Syphilis and alcohol are not factors of true epilepsy.

Pathology.—An epileptic attack is due to sudden discharge of nervous energy from the cerebral cortex. Site of origin probably varies, illustrated by differing auræ. Lower path proved by cessation of spasms on one side following hæmorrhage into internal capsule in an epileptic.

HISTOLOGY.—No constant changes.

Symptoms.—Manifestations of an attack of epilepsy are: (1) Aura; (2) Loss of consciousness; (3) Convulsions; (4) Post-epileptic phenomena. Various combinations occur, loss of consciousness, partial or complete, being rarely absent.

A. GRAND MAL.—

PREMONITORY SYMPTOMS.—Occasionally vague sensations for variable period, e.g., depression. Often none, and health good.

AURA.—*Is portion of the fit preceding loss of consciousness.* Often absent. Same aura usually recurs. Commonest forms are: (1) *Sensory*: Giddiness; fullness in the head; sensations commencing in the fingers, etc. (2) *Visceral*: Epigastric sensation commonest, may ascend to throat and head, when unconsciousness occurs (similar phenomenon occurs in other auræ); also cardiac and others. (3) *Special senses*: (a) Visual: commonest: flashes and colours. (b) Auditory: noises. (c) Smells and tastes: rare. (4) *Psychical*: Fear; Jackson's 'dreamy state' of strange

surroundings. (5) *Motor*: Rare as an aura, but with onset of unconsciousness may be sudden short run or rotations.

LOSS OF CONSCIOUSNESS.—Onset sudden, often loud cry, falls without attempt at protection.

CONVULSION.—Three stages:—

1. *Tonic Stage*.—General rigidity, but severer on one side; head retracted and rotated, and usually eyes also, to one side; elbows and wrists flexed, hands clenched, or in interosseal flexion; lower extremity extended; respiratory muscles fixed, whence lividity and rapid cyanosis; pupils dilated. Duration, few seconds.
2. *Clonic Stage*.—Twitching commences: progresses in severity and frequency to violent convulsions. Face, eyes, head, trunk, and limbs affected: mainly on one side. Jaw and tongue spasms cause *biting of tongue*. *Micturition common*. Respiration recommences noisily, and cyanosis lessens. *Frothy and often sanious saliva*. Cold sweat. Rapid pulse. Spasms diminish in frequency, often not in violence, until cessation. Duration, 1 to 2 minutes.
3. *Stage of Coma*.—Unconscious. Limbs flaccid. Congested. Deep respiration. Dilatation of pupils diminishes. Returns to consciousness gradually, or often falls asleep.

RECOVERY.—Headache, exhaustion, or slight confusion. May be vomiting, or passage of pale urine. For various sequelæ, *see below*.

REFLEXES absent during unconsciousness. On recovery, usually increased knee-jerks, ankle-clonus; plantar flexion of toes.

B. PETIT MAL.—*Transient unconsciousness without convulsions*. Onset sudden, duration short, phenomena often slight. Expression becomes fixed, pupils dilate, slight pallor; occupation interrupted, e.g., cessation of talking or articles dropped. *Micturition common*. In some cases various automatic actions, especially undressing. Recovery in few seconds, often unaware of occurrence.

Aura rare: occasionally previous slight faintness. Unconsciousness sometimes only partial. Sequelæ not uncommon.

Sequelæ to an Attack of Epilepsy.—

1. POST-EPILEPTIC AUTOMATISM.—More frequent in petit mal. May be no apparent loss of consciousness. Commonest form is continuation of day's work or actions without subsequent recollection of its performance. In other cases, various crimes and indecencies.
2. TRANSIENT HEMIPLEGIA, aphasia, or muscular weakness.
3. HYSTEROID CONVULSIONS.—In hysterical subjects, following petit mal.

Epilepsy—Sequelæ to an Attack, *continued*.

4. STATUS EPILEPTICUS.—Recurrent convulsions without regaining consciousness. Temperature rises (103° to 105°); rapid pulse and respiration. High mortality.

Course and Occurrence of Attacks.—

RECURRENCE.—Almost an essential feature. *Frequency*: from one or two yearly to hundreds. *Remissions*: interval may be years, especially from infancy to second dentition. *Health* in intervals often good, but subjects frequently irritable or neurotic.

HOOR OF OCCURRENCE OF ATTACK.—Often constant in an individual.

NOCTURNAL EPILEPSY.—Important. Wakes with wet bed, sore tongue, slight headache and confusion. Often long unrecognized.

TYPE OF ATTACK often varies. Frequently both grand and petit mal. In others, initial petit mal develops into grand mal; or vice versa, under treatment.

Diagnosis (*see also* EPILEPTIFORM ATTACKS, p. 1060).—

GRAND MAL.—Characteristics: (1) Rapid unconsciousness; (2) Tonic and clonic stages; (3) Micturition; (4) Biting of tongue. Main difficulty from *hysteroid convulsions*: (1) Onset gradual; (2) Convulsions of irregular course; (3) May talk or scream; (4) Never micturates or bites tongue; (5) Long duration; (6) Rapid return to consciousness; (7) Never injured by fall.

OVER AGE OF 30 YEARS.—Investigate for an organic cause (*see* EPILEPTIFORM ATTACKS, p. 1060).

PETIT MAL.—Diagnosis from: (1) Syncope. Cause often obvious; anæmia, emotion, cardiac disease, etc. (2) Auditory vertigo, Ménière's disease.

Prognosis.—Spontaneous cessation extremely rare, one attack predisposing to another.

PROGNOSIS FOR RECOVERY UNDER TREATMENT.—Unfavourable features: (1) Onset in infancy; (2) Petit mal; (3) Frequent attacks; (4) Long duration; (5) Mental weakness. Most favourable is late onset of infrequent grand mal, also nocturnal epilepsy. Pure petit mal is worse, and is often unaffected, or even aggravated, by treatment curing grand mal.

No special tendency to cessation at puberty. Heredity of no influence. While any attacks continue, cessation of treatment involves aggravation.

DEATH during attack confined practically to status epilepticus or injury.

EPILEPSY AND INSANITY.—Epileptics often feeble-minded from birth. Dementia may develop, especially with: (1) Attacks frequent, over long period, and commencing in early life; (2) Particularly petit mal; insanity may commence after epileptic attacks cease.

Treatment.—Ascertain all details of frequency, type, and hour of occurrence of attacks. Explain necessity of prolonged treatment. Record to be kept of all attacks and treatment.

GENERAL TREATMENT.—General quiet life. Treat any ill-health, peripheral irritation, rickets, etc. No alcohol.

EXERCISE.—Moderate. Certain forms, e.g., swimming, are obviously dangerous.

EDUCATION.—Always continue if possible, as attacks may last throughout life.

MARRIAGE.—Discourage. Great risk of epilepsy, insanity, imbecility, or neuroses in offspring. No effect on attacks if sexual intercourse moderate.

DRUG TREATMENT.—

BROMIDES are pre-eminent. Definite written instructions advisable; frequent changes to be avoided. Often control fits, sometimes cure, but when failing, other drugs rarely succeed. Administer for two years after last attack, reducing dose in second year.

DOSAGE.—For adult 30 to 60 gr. daily: maximum 90 gr. Plan large dose to precede hour of fit when known, e.g., 3ss nocte in nocturnal epilepsy; or similar dose on rising with common after-breakfast attack. Children stand bromides well.

SEQUELÆ OF BROMIDES.—(1) Acne and bromide eruption: may be obstinate. (2) Mental depression. (3) Loss of appetite.

LUMINAL.—Often valuable, especially for petit mal. Maximum daily dose for adults, 2 gr.

PRESCRIPTIONS (dosage for adults).—

R	Pot. Bromidi gr. xv	Spt. Chloroformi	℥x
	Liq. Arsenicalis ℥ij	Aq.	ad 3ss
	t.d.s., p.c.		
R	Pot. Bromidi gr. xv	Tinct. Digitalis	℥v
	Sod. Biboratis gr. v	Spt. Chloroformi	℥x
		Aq.	ad 3ss
	t.d.s., p.c.		

KETOGENIC DIET.—Fits in children are reduced by starvation, probably due to acidosis. Ketogenic diet produces ketosis by reduction of carbohydrates and substitution of high fat content. Acidosis must be positive to ferric chloride reaction. Diet borne well by children: adults object to carbohydrate shortage.

DATA FOR CALCULATING DIET.—

1. *Number of Calories (K).*—For adult 33, for children 50, per kilo body weight.
2. *Amount of Protein (P).*—For adult $\frac{2}{3}$ gm., for children 1 gm., per kilo.
3. *Calories in One Gramme.*—Fat 9; protein and carbohydrate 4.
4. *Diet Ratio.*—Commence with 1.5 to 1—viz., fat in gm. = 1.5, protein and carbohydrates together = 1. Increase to 3 to 1, or 4 to 1.

CALCULATION.—Since number of calories (K) and amount of protein (P) are known, the amount in grammes of fat (F) and carbohydrate (C) can be calculated from the formulæ (for 1.5 to 1 diet):—

$$\begin{aligned} (a) \quad & F = 1.5 (C + P) \\ (b) \quad & 9 F + 4 (C + P) = K \end{aligned}$$

Epilepsy—Treatment, *continued*.

TREATMENT DURING AN ATTACK.—Place recumbent, loosen clothing at neck, place between teeth a tongue depressor, spoon, etc. Shortening of attack impossible. Subsequently, allow to sleep; turn on side if vomiting.

ARREST OF THREATENING ATTACK.—Rarely possible. Occasionally by patient through effort of will. Rarely with aura in a finger, etc., by tying tight constriction above site.

STATUS EPILEPTICUS.—*Attempt to check convulsions.* Chloroform inhalation most effective, but fits may recur subsequently. Inject morphia hypodermically. Bromides valueless.

Tongue may fall back and need traction.

PYKNOLEPSY.

(*Friedmann-Heilbronner's Disease.*)

Onset in childhood. Characterized by attacks of petit mal, mild and short. Consciousness not completely lost; no clonic spasms; no headache. Attacks very numerous. Always cease spontaneously after duration of weeks or years. Drugs have no effect. No mental deterioration. No family history of epilepsy.

JACKSONIAN EPILEPSY.

Due to irritation of motor cortex, especially tumour (*see pp. 1014, 1015*); also trauma, inflammatory conditions; rarely in general paralysis of the insane and uræmia.

Characterized by: (1) Consciousness retained (or lost late); (2) Spasm commences in group of muscles ('signal symptom') and spreads deliberately, e.g., from fingers up arm: usually remains localized. After many years may become widespread.

EPILEPTIFORM ATTACKS.

Attacks of loss of consciousness and convulsions in adults may also occur in:—

1. Chronic alcoholism.
2. Syphilis. General paralysis of the insane.
3. Uræmia. Nephritis with œdema.
4. Eclampsia of pregnancy.
5. Injury to brain. Post-hemiplegic epilepsy.
6. At onset of vascular lesions of the brain: hæmorrhage, thrombosis, embolism. Migraine rarely.
7. Stokes-Adams' disease.
8. Encephalitis. Any type.
9. Tetany. Any origin.
10. Neoplasms. Jacksonian epilepsy. Pituitary lesions.

VIII. INFANTILE CONVULSIONS.

Convulsions resembling epilepsy, but not recurring if cause removed. Occur at age when brain still unstable. If recurrent, may develop into true epilepsy.

Causes.—*Debility* practically always present.

1. GASTRO-INTESTINAL DISTURBANCES.

2. PERIPHERAL IRRITATION, e.g., (i) Dentition: age about 6 months. (ii) Worms, phimosi, otitis.

3. TETANY, e.g., rickets.

4. INFECTIOUS FEVERS.—At onset: corresponding to rigors in adults. In whooping-cough from congestion.

5. ORGANIC NERVOUS DISEASES, e.g., meningitis, acute poliomyelitis, encephalitis.

6. EPILEPSY.

Convulsions at, or from, birth may result from injury.

Diagnosis.—Exciting cause must be sought. Vomiting and pyrexia suggest infective or organic disease. Possibility of epilepsy increases after two years.

Prognosis.—Varies with cause and frequency of attack, and condition of patient. In severe diarrhoea, prognosis very bad. In infectious fevers, importance slight.

Treatment.—

DURING PAROXYSM.—Place in warm bath (about 96° F.): douche head with cold water if pyrexia present. If severe: (a) Chloroform inhalation; (b) Chloral hydrate, gr. iij to v in enema, preferably after rectal saline wash. If recurrent, inject morphia, gr. $\frac{1}{16}$ to $\frac{1}{8}$.

DENTITION.—Lance gums only if swollen and hot. Castor oil.

SUBSEQUENTLY.—*Treat cause.* If convulsions recurrent over a period, give bromides as in epilepsy.

IX. PERIODIC PARALYSIS.

A rare familial and hereditary disease characterized by recurrent attacks of flaccid paralysis.

Etiology.—Familial and hereditary. Both sexes affected. Attacks commence about puberty. *Exciting causes* unknown. No pathological changes. *Pathogenesis* is unknown: origin probably in muscles. Migraine may occur in family.

General Description.—Recurrent attacks of transient flaccid paralysis. Prodromata absent, or slight aching. Paralysis commences in legs, often at night: spreads to arms and trunk: usually complete in twenty-four hours. *Recovery* begins within twenty-four to forty-eight hours: reverse order to onset. Cranial nerves rarely, and diaphragm very rarely affected. No mental, sensory, or sphincter changes. Temperature normal. Reflexes absent. Heart may be dilated. *Recurrences*, usually one to two weeks' interval: may cease in later life. Death in attack, rare. Creatinine excretion diminished during attack.

A recurrent oculomotor and a recurrent facial paralysis also exist.

X. NARCOLEPSY.

A condition characterized by attacks of irresistible sleep (narcoleptic) and attacks of loss of postural tone without loss of consciousness (cataplectic).

Characteristics.—Onset at any age. Mostly males. Lasts through life.

1. **NARCOLEPTIC ATTACKS.**—Irresistible sleep: usually brief, few seconds or minutes: many daily. Depth of unconsciousness varies: generally complete. Rousable as in normal sleep.
2. **CATAPLECTIC ATTACKS.**—Occur with emotion, especially pleasurable, e.g., sudden laughter. Muscles suddenly relax; patient sinks limply to the ground; knee-jerks absent, extensor plantar response, pupils react to light. Fully conscious, but unable to speak. Duration: generally few seconds.

Nature of Attacks.—Are 'inhibitory phenomena', narcoleptic involving whole cortex, cataplectic confined to voluntary movement and postural tonus (Adie). Similar narcoleptic attacks occur in certain endocrine or metabolic disturbances, e.g., pituitary; also in cerebral tumour, epidemic encephalitis, head injury, epilepsy.

Treatment.—No treatment effective. May improve in later life.

CHAPTER CLXXV.**PSYCHONEUROSES.****I. HYSTERIA.**

A condition in which ideas control the body, and produce morbid alterations in its functions. Note:—

1. Hysterical manifestations never occur during sleep, or when an audience is believed to be impossible.
2. Symptoms are bizarre and contradictory from the aspect of organic disease—e.g., sensory changes have not the correct distribution for any organic lesion.
3. There is an absence of signs of such organic disease as might cause the symptoms.
4. Sudden cure may occur at any time.
5. Considerable mental abnormality is present in most hysterics.
6. Organic disease may coexist—and may induce onset of hysterical manifestations. Diagnosis is of extreme difficulty: often overlooked, with great public discredit to the profession.

Etiology.—

AGE.—Commonest between 15 and 30 years. Rarely from 8 to 15 years. When established, may persist throughout life, mainly in women.

SEX.—Females predominate. In civil life rare in adult males.

HEREDITY.—Of greatest importance, a neuropathic family history. Additional factor is deficient training and control in childhood; often further influenced by neuroses in the mother.

RACE.—Latin, Jewish, and Slav races are specially susceptible. Major convulsions very rare in other races.

EXCITING CAUSES.—Shocks, especially psychical, e.g., love affairs, fright. The necessary degree of shock varies with the instability of the subject. Depressed general health.

Theories of Hysteria.—No organic disease of the nervous system present. Theories are numerous, mostly of great complexity, and need reference to special works.

1. **CHARCOT.**—Psychosis. The body is controlled by ideas.
2. **BABINSKI.**—Manifestations are due to auto-suggestion. Various impressions are excluded from the patient's consciousness, e.g., from a certain limb; in extreme forms even dual personality, each identity being unaware of the other. Thus differing from dual personality in psychasthenia which is recognized by the subject.
3. **FREUD.**—Sexual activities, often perverse, occur mentally in the period before puberty, constituting mental traumata. These may be repressed to the subconscious mind, where they remain unneutralized, though forgotten by the conscious mind. Resuming activity later, in certain circumstances, these sexual mental traumata, though they may still remain subconscious, influence the conscious mind, and produce hysterical manifestations.

Freud thus refers all hysteria to a sexual origin, as the Greeks of old. By 'psycho-analysis' and study of dreams, the physician patiently drags out the original skeleton, exhibits it, and lays the ghost.

Symptoms.—Of every degree and variety. May simulate practically every organic disease of the nervous system and many of other systems. A summary is given first, and then certain additional details. Often many varieties coexist, or follow in same individual.

SUMMARY.—

A. CONVULSIVE FORMS.—(1) Minor hysteria. (2) Major hysteria (hystero-epilepsy).

B. NON-CONVULSIVE FORMS.—

1. *Psychical Forms.*

2. *Motor System.*—(a) Contractures and spasms; (b) Paralyzes; (c) Tremors; (d) Spasmodic movements.

3. *Sensory System.*—(a) Pain of every variety; (b) Anæsthesia; (c) Hyperæsthesia; (d) 'Hysterogenic spots.'

4. *Special Senses.*—(a) Restriction of field of vision; (b) Deafness, or extreme sensitiveness of hearing; (c) Absence of smell or taste, or extreme sensitiveness.

5. *Alimentary System.*—(a) Dyspepsia of every variety; (b) Diarrhœa, constipation, vomiting; (c) 'Phantom tumour' (and pseudo-cyesis). Rarely: (d) Anorexia nervosa; (e) Ileus, irritable rectum, anospasm.

6. *Respiratory System.*—(a) Rapid respiration; (b) Cough; (c) Hiccup, yawning; (d) Hæmoptysis.

Hysteria—Symptoms, *continued*.

7. *Cardiovascular System*.—(a) Tachycardia ; (b) Pseudo-angina ; (c) Flushing, sweating.
8. *Joint Affections*.
9. *Sphincter Affections*.
10. *Pyrexia*.

MOST CONSTANT SYMPTOMS FOR GENERAL DIAGNOSIS OF HYSTERIA.—

1. *Psychical symptoms*.—Rarely absent. Especially laughing and crying attacks, fainting, emotions, 'globus hystericus'.
2. *Anæsthesia*.—(i) 'Glove' or 'stocking' type ; (ii) Hemianæsthesia.
3. *Fields of vision constricted* : with progressive spiral diminution.
4. Exaggerated symptoms with negative physical signs, temperature normal, plantar reflex flexor.
5. 'Clavus hystericus'. Pains in back. Heart complaints. Retention of urine.

A. CONVULSIVE ATTACKS.—

1. *MINOR FORMS*.—Preceded by emotional disturbance (*see PSYCHICAL FORMS*). Then irregular clonic movements. Falls without injury. Does not bite tongue, or pass water. Becomes 'unconscious'. Gradual recovery with much emotional display : often passes flatus or much pale urine. Subsequently, hazy recollection of occurrence. Torpor or catalepsy may follow.
2. *MAJOR FORMS (Hystero-epilepsy)*.—Mainly in Latin races. Very rare in British Isles and America. Various contortional attitudes, due to suggestion.

B. NON-CONVULSIVE ATTACKS.—

1. *PSYCHICAL FORMS*.

- i. *Acute Mild Forms*.—Alternate laughing and crying, 'Globus hystericus' and constriction in throat. Fainting, excitement, and emotions (rarely, may pass into mania).
- ii. *Severe Forms*.—(a) Trance. (b) Catalepsy : limbs flaccid but remain in any position in which placed : trance coexists. (c) Status hystericus : in bed for months oblivious to all, breath foul, delirium : may be suicidal.

- iii. *Chronic Forms*.—Desire for sympathy leads to exaggerated symptoms, to self-inflicted wounds, to long-continued deceptions bordering on malingering.

2. *MOTOR SYSTEM*.—

Spasmodic contractures.—Onset spontaneous, or following emotion, pain, fit, or injury. Spasm powerful, increased by efforts to relax, often persists in sleep, relaxed under anæsthetics ; often disappears suddenly even after long duration ; may recur.

Distribution : Monoplegia (hysteria being commonest cause of such), arm or leg, latter simulates lateral

sclerosis. Also hemiplegia, paraplegia, ptosis, trismus, and 'phantom tumours'.

Paralyses.—May simulate any organic disease. Characters :
 (i) Paralysis rarely absolute, e.g., unable to stand or walk, but free leg movements in bed ('astasia abasia').
 (ii) Movement opposed by contraction of antagonistic muscles (occurs only in hysteria). (iii) No wasting of muscles. (iv) Anæsthesia common. (v) Reflexes increased; plantar reflex flexor; pseudo ankle-clonus common. (vi) Electrical reactions normal. Duration: transient or for years. Later: atrophy from disuse, tendon contractions, and joint changes.

Distribution: (a) Paraplegia, commonest. (b) Hemiplegia: tongue may deviate towards affected side: hemianæsthesia usual. (c) Monoplegia: usually with 'glove' or 'stocking' anæsthesia. (d) Larynx: adductors of vocal cord, very common, aphonia or whispering; often cured by examining larynx, or by electric current. Other cranial nerve distributions rare.

Tremor.—Common. Type varies: usually fine tremor of hand. Increased by voluntary movements. May be 'intention tremor', whence early disseminated sclerosis often diagnosed as hysteria.

Spasmodic movements.—May be: (a) Irregular, as in chorea. (b) Repeated, as in 'habit spasms', or rhythmical: sometimes a single muscle, e.g., psoas. (c) Rarely, complex and purposive, e.g., salaaming.

3. SENSORY SYSTEM.—

Pain of every variety. Commonest: 'clavus hystericus' (nail driven into head), and in back. Simulates many diseases, e.g., caries of spine, appendicitis, gastric ulcer: pseudo-physical signs increase difficulty.

Anæsthesia.—Very common. Must be looked for: patient often neither complains nor knows. Usually complete to all sensations, but occasionally 'dissociation'. Includes deep structures and mucous membranes within area. Bleeding slight on pricking. Muscular sense often preserved, e.g., sewing. 'Allocheiria' occasionally: touch, etc., referred to other sites. Duration: may be years, yet disappear suddenly. On treatment, may change sides and then revert.

Distribution: (i) Hemianæsthesia: sharply limited at mid-line, includes palate; conjunctiva escapes usually. (ii) 'Glove' or 'stocking' anæsthesia of limbs. Sharp circular line of demarcation, i.e., corresponds to no nerve or root distribution.

Hyperæsthesia.—In various areas. May be to light touch or deep pressure.

'Hysterogenic Spots.'—Common sites of symmetrical hyperæsthetic spots are ovarian, inframammary, and

Hysteria—Symptoms, *continued*.

over dorsal spines. Extreme tenderness. Pressure often induces other hysterical symptoms.

4. SPECIAL SENSES.—

Sight.—Fields of vision frequently affected. Characters

- (i) Field constricted. (ii) As perimeter observations are continued, *field diminishes in a spiral* (pathognomonic).
- (iii) Reduction greatest for blue and least for red (contrary to organic disease). (iv) With hemiplegia, constriction of field is often on the same side, crossed amblyopia. Blindness rare. Excessive sensitiveness to light.

Hearing.—Deafness, or excessive sensitiveness to sound (hyperacusis).

Absence of taste and smell: very common.

5. ALIMENTARY SYSTEM.—

Dyspepsia of various types. Appetite failing; hyperchlorhydria; difficulty in swallowing and regurgitation from spasm of œsophagus. Fasting is often fraudulent. Flatus and borborygmi common ('peristaltic unrest').

Diarrhœa, often very resistant, of lenteric type. Constipation common. Vomiting common; rarely fecal.

'Phantom tumours' in abdomen. Result from spasm of diaphragm with relaxation of abdominal muscles, intestinal distension with gas, and arching of vertebræ. Simulate tumours or pregnancy, especially at menopause ('pseudo-cyesis'). Relax under anæsthetics.

Anorexia Nervosa.—See p. 1071.

Ileus. Irritable anus. Anosperm.

6. RESPIRATORY SYSTEM.—

Rapid respiration. Deep breaths.

Cough. Especially 'barking cough of puberty'.

Hiccup; yawning.

Hæmoptysis: usually from pharynx. Simulates phthisis.

7. CARDIOVASCULAR SYSTEM.—

Tachycardia, common.

Complaints of precordial pain. Pseudo-angina (*see* p. 834). Flushing, sweating.

'Stigmata' or hæmorrhages into the skin are mainly if not invariably fraudulent.

- 8. JOINTS.—Usually single large joint affected, hip or knee. Painful, with wide superficial and deep tenderness, muscles contracted: may be trophic changes, some œdema and warmth. No real shortening; no changes in radiogram; normal under anæsthetic. Often cured by 'quack' methods.

- 9. SPHINCTERS.—Retention common. *Never incontinence*, except by overflow. Passage of much pale urine common.

- 10. FEVER.—Temperature practically always normal. Pyrexia in rare instances. Hyperpyrexia repeatedly proved fraudulent.

Prognosis.—Liability to hysterical manifestations persists for many years, usually diminishing after age of 30 to 35 years.

In a given symptom, e.g., paralysis, duration cannot be foretold : after existing many years may disappear suddenly, often following a shock. No symptom is necessarily permanent.

Anorexia nervosa and, very rarely, persistent vomiting are the only hysterical manifestations with definite mortality.

Diagnosis.—Inquire into previous hysterical symptoms, family history, and make *complete physical examination*. Of the most constant symptoms (*see SUMMARY above*), several are almost invariably present, and make diagnosis simple.

DIFFICULTIES.—

1. EXCLUSION OF ORGANIC DISEASE OF NERVOUS SYSTEM.—

Diagnosed as hysteria are : (i) *Early disseminated sclerosis*, frequently ; (ii) Intracranial tumour, occasionally.

2. PRESENCE OF BOTH HYSTERIA AND ORGANIC DISEASE.—

Possibility always to be considered.

3. DISTINCTION OF HYSTERIA FROM PURE MALINGERING.

Treatment.—The physician's responsibilities include : (1) Treatment of the patient. (2) Choice of a nurse. (3) Treatment of the patient's relatives. Relatives frequently have also hysterical taint ; are over-sympathetic, or, per contra, bully the patient ; are partly responsible for condition ; and difficult to deal with : hence advisable, and often essential, to remove patient from home. To the patient, physician must never give impression that he considers that she is malingering, and that " it is her own fault " ; he should give an explanation of condition and probability of recovery ; and must gain her confidence. Treatment necessarily varies with each symptom and patient.

MILD FORMS.—Changes of scene. General health attended to. *Aperients*. Later : general tonics and *suitable occupation*.

SEVERER FORMS.—Isolation in bed usually necessary for varying periods. Forms of treatment include :—

HYDROTHERAPY.—In minor psychical forms, in fits and spasm, cold water applied with apparent disregard for clothing frequently effective, or a cold bath. In more chronic conditions, cold spinal douche valuable.

ELECTRICITY.—Strong faradic current (harmless pain) frequently arrests convulsions.

MASSAGE.—Of value for general nutrition.

COUNTER-IRRITATION, BLISTERS.—Often effective by suggestion.

DRUGS.—*Morphia always to be avoided*. Hypodermic injections of water often equally effective for sleeplessness.

Narcotics.—Avoid if possible. Cachets of sugar often effective.

Valerian and Asafetida.—Valuable, especially in chronic minor forms, e.g., dyspepsia.

R. Tinct. Valer. Ammon. ℥xxv | Aq. Camph. ad ʒss
Tinct. Asafetida ℥xxv |

Bromides.—Of great value. May be combined with last.

SPECIAL METHODS OF TREATMENT.—

1. **WEIR-MITCHELL.**—Isolation : massage : large quantities of milk. (*See NEURASTHENIA*, p. 1070.) The relaxation of each

Hysteria—Treatment, continued.

- restriction should depend on improvement, and be re-imposed on relapse; the condition being explained to patient.
2. **HYPNOTISM.**—Inadvisable.
 3. **SUGGESTION.**—Good results with selected cases in reliable hands.
 4. **FREUD'S METHOD.**—'Psycho-analysis.' Aim is to elucidate an original cause for hysterical manifestations, these being, according to Freud, of sexual origin. Method is complex, and theory and result still under trial.

II. NEURASTHENIA.

A functional condition in which exhaustion of the vitality of the nervous system causes inefficiency of the mind and body. The 'vital force' of the nervous system is insufficient for the normal stress of life, either hereditarily, or from some exceptional strain to which the individual has been subjected.

Etiology.—

AGE.—Usually 25 to 50 years.

SEX.—Commoner in males.

HEREDITY.—Born neurasthenics are common.

PROLONGED MENTAL WORRY.

SPECIFIC DISEASES.—Especially influenza (even mild) and severe enteric.

DRUGS.—Cocaine, morphia, alcohol; but drugging often results from neurasthenia.

TRAUMA.—Special type (*see* TRAUMATIC NEUROSES, p. 1072).

SEXUAL FACTORS.—Influence and mode undecided.

Symptoms.—Very varied. Certain common basic symptoms, usually with accentuated disturbance in various systems, constituting different types, viz., psychical (or cerebral), motor (or spinal), gastric, sexual, cardiac, and other visceral forms. Distinction of types often over-exaggerated.

GENERAL SYMPTOMS AND CONDITION.—Common phenomena :—

APPEARANCE.—Often characteristic of depressed bodily and mental vigour, of tiredness and despondency, with pinched facies of vasomotor disturbance.

LOSS OF WEIGHT.

PALLOR and some anæmia usual.

SUBJECTIVE SYMPTOMS MARKED, with slight objective signs. Described by subject in over-full detail.

RESTLESSNESS.—*Worried by trifles.* Irritable, despondent, and egotistical.

HEADACHE.—Often vertical oppression. Vague sensations common, e.g., 'brain feels too big for the head'.

PAINS IN BACK.

INSOMNIA or unrefreshing sleep.

HYPERÆSTHESIA.—From tinglings, formication, etc., to pains in various sites.

PSYCHICAL OR CEREBRAL FORM.—'Anxiety neurosis'. Loss of power of concentration and mental work. '*Phobias*' very common. Frequent fear of death, insanity, poverty, etc. Various severe forms, e.g., (1) Agoraphobia, fear of open spaces; (2) Claustrophobia, fear of closed rooms. Other symptoms in this group: Restlessness, bodily and mental. Involuntary mental activity: thoughts run rapidly through the head.

MOTOR OR SPINAL FORM.—Muscular weakness, may be extreme. Pains in back and limbs. Tender spots on spine not uncommon. Hyperæsthesias and visceral neuralgias common. Muscles flabby; often fine tremor of hands; may be some inco-ordination.

SPECIAL SENSES—Often disturbed, especially vision. Eyes tire rapidly (errors of refraction common). Hyperacusis.

CIRCULATORY SYSTEM.—Important and common changes.

Vasomotor Disturbances.—May be: (1) Peripheral vessels contracted: extremities blue, pinched facies, desire for warmth. (2) Peripheral vessels relaxed: (i) Arterial pulsation marked, especially abdominal aorta; (ii) Capillary pulsation; (iii) *Pulse* almost water-hammer. Other signs are: (3) Flushing or blushing frequent; profuse sweating (may be nocturnal).

GASTRIC AND GASTRO-INTESTINAL FORM (*see* GASTRIC NEUROSES and MUCOMEMBRANOUS COLITIS).—Constipation, poor appetite, and flatulence common in all forms.

SEXUAL FORM.—Some complaint of sexual functions almost invariable. Spermatorrhœa common: frequent nocturnal emissions, or sometimes after defæcation. Other complaints are: fear of impotence, presence of nervous impotence, 'irritable testis', aching in pelvis or genitals, and in women, tender ovary or dysmenorrhœa.

CARDIAC FORM.—Palpitations, præcordial sensation, rapid heart-beat, often dizziness. Characterized by abnormal increase of heart-rate on slight exertion. Vasomotor disturbances, as above, common. Occasionally pseudo-angina. Other signs of neurasthenia may be slight.

SENSORY SYSTEM.—Tingling, formication, hyperæsthesia, etc.; pain in various sites.

URINE.—Often scanty, with increased urates, oxalates, or sometimes phosphates. Micturition may be frequent. *Never incontinence.*

ON EXAMINATION.—No signs of definite organic disease. *Reflexes* increased or normal. Knee-jerks increased; plantar reflex flexor; no ankle-clonus. No definite paralysis. No Romberg sign, but swaying often exaggerated. *Pupils* dilated, rarely unequal, reactions normal. Errors of refraction common. No alteration of the field of vision.

Special Types.—Certain types are separated from the main group by some authorities, especially: (1) Anxiety neurosis; (2) Psychasthenia.

ANXIETY NEUROSIS.—The subject is constantly and causelessly in the physiological state which occurs in normal persons under anxiety: i.e., pallor, cold sweats, tachycardia, shallow breathing,

Neurasthenia—Special Types, continued.

gastric discomfort, etc. The anxiety may be attached to a single concrete idea—e.g., fear of insanity—or may be uncrystallized.

PSYCHASTHENIA.—A group including many cases akin to, and often classified as, psychic or cerebral neurasthenia. Onset in youth; hereditary factor; persists through life with remissions. Main features (Janet) are: (1) Certain *stigmata* of indecision: (a) Inability to concentrate attention, doubts, hesitation, even feeling of dual personality (*see* HYSTERIA, p. 1063); (b) Physical; clumsy movements, tics. (2) *Obsessions* of all kinds, from minor grades to kleptomania, crime, and sexual acts. (3) *Imperative ideas or acts*: tics, phobias. General neurasthenic symptoms may be present. Reaches borderland of insanity; but no delusions, hallucinations, or impairment of memory.

Diagnosis.—From two groups of conditions: (a) Organic diseases, especially cerebral tumour, Addison's disease, tabes, dementia paralytica, and the rare myasthenia gravis; (b) A chain of psychoses and neuroses, from hysteria to the borderland of insanity. Examination should always be complete; Wassermann reaction advisable. Serious organic disease of any kind, e.g., cancer, may suggest neurasthenia.

TABES.—Resembles spinal form of neurasthenia. Differs in reflexes and pupil changes.

DEMENTIA PARALYTICA.—May commence like neurasthenia. Note: impaired memory, defects in articulation, pupil changes, cerebrospinal fluid.

HYPERTHYROIDISM AND EXOPHTHALMIC GOITRE may resemble cardiac form.

HYSTERIA.—Diagnosis by stigmata: anæsthesia, restriction of visual fields, contractures, convulsions. Often difficult.

HYPOCHONDRIASIS.—Conviction that sensations are due to organic disease. Actual delusions occur.

Prognosis.—*Recovery* never rapid, recurrences common; but cures may be effected and great improvement can be promised with proper treatment. Favourable factors in prognosis: (1) Patient's circumstances permitting treatment; (2) Removable cause; (3) Short duration; (4) Previous health good and no hereditary neurosis.

Treatment.—Make certain of absence of organic disease, and reassure patient.

Indications are: (1) Remove the cause; (2) Rest and restore the nervous system. Plans must be adapted to the patient, his story carefully heard, and his confidence gained.

REST.—In cases of worry and overwork, a prolonged rest and absence—at least six months. In severer forms, a nurse and a daily routine. In most severe cases, 'Weir-Mitchell treatment' or 'rest cure'; principles being: (1) Prolonged rest in bed away from home and friends, at least six weeks; (2) Abundant simple diet beginning with milk; (3) Massage. Results often excellent, sleep returning, weight increasing, and nervous system calming.

BOWELS.—Regulate motions.

PERIPHERAL IRRITATION, local disease, and septic foci must be searched for and treated, e.g., errors of refraction, anaemia, gastric or intestinal disturbances, movable kidney, genital and pelvic diseases, oro-nasal infections.

DRUGS.—Of subsidiary value except for special symptoms.

GENERAL TONICS.—Arsenic, iron, strychnine, glycerophosphates.

SEDATIVES when pains severe: bromides, phenacetin, aspirin. Withdraw when possible. Avoid alcohol, morphia, and chloral hydrate.

HYDROTHERAPY.—Often of great value. Wet packs, douches, or elaborate methods of spas. *Electricity* may well be combined.

PSYCHOTHERAPY.—Suggestion and its various developments, and, in some cases, Freud's psycho-analysis (see **HYSTERIA**, p. 1068), have effected many cures, with selected cases, in proper hands.

INSOMNIA.—Avoid drugs if possible. Hot drinks or a little food; wet packs; Weir-Mitchell treatment. Trional and sulphonal if necessary.

PROPHYLAXIS.—Neurotic children need careful watching; protection from educational strain, and special attention at puberty. When they become adults, should have regular holidays. Exercise and fresh air of great value, but strength not to be overtaxed.

III. ANOREXIA NERVOSA

A functional condition, without recognizable organic disease, characterized by complete loss of appetite or refusal of food resulting in severe wasting.

Etiology.—Mainly females, age 15 to 25 years. May occur at any age in either sex. Occasionally in old age.

Pathogenesis.—Loss of appetite probably always originates in refusal of food. Anorexia develops from not taking food, and once established is perpetuated as a hysterical condition. Two groups can be recognized:—

1. **PSYCHOPATHIC ORIGIN.**—Exciting cause may be sudden emotional shock or long-continued disturbance, e.g., marriage of younger sister. Sexual basis probably invariable. Incident not always ascertainable: often denied. May be considerable interval before symptoms manifest.

In this group, following manifestations usual: (i) Psychopathic tendencies obvious in mother (or both parents): exhibition or assertion of over-anxiety, affection, and lack of tact. (ii) Small physique. (iii) Abnormality of sexual development: organs undeveloped; amenorrhœa (usually precedes anorexia). (iv) Hirsuties: in normal sites, or on trunk and limbs. Suggestive of endocrine deficiency.

2. **PRIMARY ABSTINENCE FROM FOOD.**—May arise from desire to 'slim'. May be initially fat and tall. Some psychopathic features usually recognizable.

Anorexia Nervosa, continued.**Symptoms.—**

Aversion to all food: Asserts loathing for food or sense of repletion after one mouthful. *Loss of weight:* Continues to extreme emaciation. *Physical energy:* Surprisingly retained. Patient asserts that health is perfect. *Constipation. Peripheral circulation:* Cyanosis and cold limbs. *Amenorrhœa. No pain. Vomiting:* Often self-induced. *Specific evidence of vitamin-deficiency:* Rare. *Blood-sugar curve:* Not constant; may be low or high. *Basal metabolic rate:* Low. *Gastric juice:* Normal.

Treatment.—Mother often as troublesome as patient.

Removal from home: Usually essential. *Rest in bed. Psychotherapy:* Good nurse often sufficient. *Diet:* Persuasion and patience. Small meals at beginning.

Prognosis.—Most recover. Death may occur from: (1) Cardiac failure; (2) Tuberculosis; (3) Coma, possibly hypoglycæmic.

IV. TRAUMATIC NEUROSES.

(*Traumatic Neurasthenia. Railway Spine.*)

A group of conditions following shock, bodily, mental, or both with symptoms of neurasthenia, hysteria, and various psychoses.

Etiology.—May follow: (1) Mental shock; (2) Concussion or accidents involving bodily injury; (3) Concussion or accidents without bodily injury. Mental shock is included in the latter groups.

Symptoms.—Several groups. Normal excitement, of few days' duration, immediately following above events, is not included.

1. *Traumatic neurasthenia.*—Interval of days or weeks usual between cause and onset of symptoms. Cause generally includes concussion (groups (2) and (3) of ETIOLOGY). Symptoms of ordinary neurasthenia, often of spinal form ('railway spine').

2. *Groups with symptoms of hysterical or mental nature, or psychoses.*—Condition immediately follows cause, which involves marked mental shock. Symptoms various: headache, apathy, loss of memory, emotional states, etc., in various combinations. Hysterical anæsthesia not common; restriction of visual fields more frequent. (Includes 'shell-shock'.)

Prognosis.—(1) In simple traumatic neurasthenia the prognosis is good. In claims for compensation, recovery is unusual before conclusion of litigation; if interval has been lengthy, recovery not invariable even if action successful. (2) The second group is frequently very resistant to and needs prolonged treatment; various psychoses, melancholia, delusions, and dementia may develop.

Diagnosis.—From: (1) *Malingering*, especially in neurasthenic group. May need considerable observation. (2) *Definite injury and organic lesions of nervous system.* Examine for signs of cord and brain injury and bladder troubles. X rays.

V. TICS: HABIT SPASMS.

A tic ('twitch' or 'jerk') is an involuntary co-ordinated movement. The apparently purposive nature would suggest that it was performed originally for a reasonable cause—e.g., head tic suggests irritation from a collar. In fact, a tic does not so arise, and is in origin, repetition, and persistence a psychical disorder.

RELATION TO 'SPASMS'.—A 'spasm' is a motor reaction resulting from irritation at some point in a reflex spinal arc or bulbo-spinal arc, is independent of consciousness or the will, and has no psychical factor.

Certain conditions are as yet undetermined as 'spasms' or 'tics': e.g., facial spasm, spasmodic torticollis.

Nomenclature is confused: thus 'habit spasm' is a tic; movements in 'tic douloureux' are spasms; 'chorea major' is hysteria.

RELATION TO HYSTERIA.—Tics merge into hysteria, especially severer tics, viz., saltatory spasms, chorea major.

RELATION TO INSANITY.—Psychical tics and obsessions merge into monomania.

RELATION TO SYDENHAM'S CHOREA.—None. No relation to acute rheumatism or endocarditis.

Etiology.—

AGE.—After early childhood at any age, especially puberty. Not under 4 years.

SEXES.—Equal.

HEREDITY.—Subjects often clever, but neuropathic taint.

PREDISPOSING CAUSES.—Debility or mental strain. Mimicry occasionally. Rarely follows Sydenham's chorea.

Morbid Anatomy.—No changes.

Groups of Tics.—(1) Simple tics or 'habit spasms': common. (2) Co-ordinate tics: rare. (3) Convulsive tics: very rare. (4) 'Psychical tics': not common. (5) Various conditions allied to, and sometimes described as, tics: spasmodic torticollis, facial spasms, saltatory spasms ('jumpers'), chorea major, latah.

1. Simple Tics or 'Habit Spasms'.—

MOVEMENTS.—(1) Limited usually to small groups of muscles.

(2) Under control of will to some extent: attempt to restrain is severe mental effort, often followed by specially severe tic and depression at failure. (3) Later become habitual and unconscious.

(4) Cease in sleep; increased by excitement. (5) Same movement is repeated; intermissions complete. (6) Often of *extreme rapidity*; less commonly, slow and deliberate (usually larger tics). (7) Always co-ordinated; purposive in character, but causeless and resultless.

VARIETIES OF TIC.—Innumerable: especially of face and head. Frequent are: twitchings of mouth or eyebrows; blinking, often with jerks of head; shrugging of shoulders; sniffing (respiratory tic). Lower limbs less common.

Simple Tics, *continued*.

PROGNOSIS DEPENDS UPON :—

AGE.—With onset in childhood, often cease ; onset in adults, often permanent.

DURATION.—The longer it has lasted, the more difficult it is to cure.

MENTAL CONDITION AND NEUROPATHIC FAMILY HISTORY.

CAUSE.—Arising from definite stimulus (peripheral irritation, ill health) better than causeless onset. Shock occasionally arrests tic, permanently or temporarily.

No effect on duration of life.

DIAGNOSIS.—By characteristics of : (1) Repetition ; (2) Complete intermission ; (3) Purposive ; (4) Co-ordinate ; (5) Extreme rapidity (usually).

CHOREA.—Purposeless ; not repeated ; cure comparatively rapid ; relation to rheumatism.

HYSTERIA.—Movements may be identical, but other stigmata present, e.g., globus, anæsthesia, contraction of visual fields.

REFLEX SPASMS.—Difficult. Confined to some definite nerve distribution.

TREATMENT.—

GENERAL.—Remove any irritation, e.g., adenoids, ocular defects, prepuce. Avoid overstrain mentally, and ensure mental rest. Suggestion, in severe forms.

MOVEMENTS.—Subject stands motionless before mirror, at first for few seconds, then longer : persist for weeks after cessation of tic.

EXERCISES to use affected and antagonistic muscles rationally.

DRUGS.—Aspirin. Luminal, gr. $\frac{1}{2}$ –i, t.d.s. Bromides.

2. **Co-ordinate Tics.**—Applied to complex tics involving complex movements, otherwise no distinction from simple tics.

Note.—All tics are co-ordinated movements.

3. **Convulsive Tics** (*Gilles de la Tourette's Disease*).—

AGE.—Usually in children, rare after puberty. Neuropathic family history generally marked. Condition borders on insanity.

Four characteristics : some or all may be present together :—

i. **MUSCULAR CONTRACTIONS.**—Movements as in simple tics, but greatly exaggerated ; occur in attacks ; repeated irregularly.

ii. **EXPLOSIVE UTTERANCES.**—Irrelevant words ; oaths ('coprolalia'). Occur with or before movements.

iii. **IMPULSES OF MIMICRY.**—Echolalia or echokinesis (mimicry of actions).

iv. **MENTAL 'OBSESSIONS' : 'PSYCHICAL TICS'.**—Repetition of a certain word, action, or number before performing any action.

TREATMENT.—Rest of body and brain. Suggestion. Massage. Baths. Electrical treatment.

4. **'Psychical Tics'.**—Innumerable varieties of obsessions : e.g., adult avoids stepping on line between flagstones. No movements occur. Allied to hysteria and monomania, but regardable

as 'tics of the brain'. Famous instances occur amongst the world's greatest men.

TREATMENT.—Often incurable: many are harmless: may drift into insanity. General treatment and suggestion.

5. Various Allied Conditions sometimes described as Tics.—

SPASMODIC TORTICOLLIS.—See p. 1077.

FACIAL SPASM.—A spasm and not a tic. (See below.)

SALTATORY SPASMS ('Jumpers').—Described as 'contraction of muscles of lower limbs occurring when soles are placed on the ground', viz., 'jumpers'. In men and women with neuropathic taint: may be epidemics. Usually transitory, sometimes lasts for years.

CHOREA MAJOR.—True hysteria. Various dancings and movements occurring as epidemics in religious excitement of Middle Ages.

LATAH.—A special psychosis of Java and Borneo. The subject is compelled to perform any action dictated by any person. Usually persists through life.

VI. FACIAL SPASM.

Spasms confined to muscles supplied by the 7th nerve fall into two groups:—

1. **ORGANIC DISEASE OF NERVOUS SYSTEM.**—Irritation of cerebral cortex; or compression of nerve trunk by tumour, etc., at base of brain.

2. **IDIOPATHIC FACIAL SPASM.**—No organic disease.

Spasm of facial muscles also occurs in many conditions not to be considered as 'facial spasm', e.g., chorea, epilepsy, hysteria, habit spasms and tics, tetanus, tetany, athetosis; also in muscles paralysed in previous Bell's palsy.

Idiopathic Facial Spasm.—

ETIOLOGY.—Age 45 to 60 years. Females commoner than males. No heredity. Often no exciting cause. Sometimes peripheral irritation, carious teeth, etc.; in others emotion or shock.

When established, paroxysms often excited by cold, draughts, emotion, voluntary movements.

SYMPTOMS.—Spasms usually *unilateral, clonic, occurring in paroxysms, and without paresis*. Occur in all degrees of severity and range. At onset often slight and occasional, later becoming severer.

IN TYPICAL FORMS OF SEVERER CHARACTER.—Paroxysm commences with slow contractions of limited range, becoming faster and faster and more diffuse until a tonic contraction occurs: passes off with diminishing contractions but usually of wider range.

DISTRIBUTION OF SPASM.—Orbicularis palpebrarum and zygomatic muscles most commonly affected. Severe attack usually commences there. All muscles may be affected, including platysma and stapedius. Severe attack may spread to opposite side.

SENSATION AND ELECTRICAL REACTIONS.—Unchanged.

Idiopathic Facial Spasm—Symptoms, *continued*.

PARTIAL FACIAL SPASMS.—Extremely common, especially blepharospasm (eyelids). Blepharospasm may be : (1) Clonic, rapid winking ; also in tics and hysteria. (2) Tonic, usually a reflex with photophobia ; eyelids closed for several minutes. Spasm may be very limited, fibrillary twitching of muscles ('live blood in the eye').

COURSE AND PROGNOSIS.—Severer forms often intractable, and when ceasing, relapses common. No effect except mental depression.

DIAGNOSIS.—By characteristics of (1) persistence, (2) paroxysms, (3) absence of paralysis. Diagnosis from (a) organic disease, (b) other conditions of spasm.

ORGANIC DISEASE.—Some paralysis or paresis present.

HYSTERIA.—Spasm tonic. Other stigmata.

TICS.—Some voluntary control. Not limited to 7th nerve distribution.

REFLEX FROM PERIPHERAL IRRITATION.—Often tenderness of 5th nerve trunks on pressure.

TREATMENT.—*Indications* : (1) Ascertain cause ; (2) Remove any peripheral irritation.

GENERAL HYGIENE.—Maintain general health ; avoid draughts, cold, and stimuli.

DRUGS.—Little value. Aspirin. Luminal. Avoid morphia.

MILD TYPES (e.g., 'live blood in eye').—Usually yield to general treatment, local light massage, bathing, and gentle pressure at supra- or infra-orbital foramina.

SEVERE TYPES.—Frequently intractable. Special measures : (1) Schlösser's treatment : injection of alcohol into nerve at stylomastoid foramen, producing facial paralysis. Spasm returns as paralysis passes, but usually several months' relief, and can be repeated. (2) Operation : division of nerve and anastomosis with spinal accessory.

VII. SPASMS OF THE MUSCLES OF MASTICATION.

Spasm may be : (1) Tonic ('trismus') ; or (2) Clonic. Usually part of a general condition : less often of local origin.

1. Tonic Spasm ('Trismus' or 'Lock-jaw').—Inability to separate teeth. Occurrence :—

GENERAL CONDITIONS.—Tetanus. Epileptic fit, tonic stage. Rarely in hysteria and tetany.

LOCAL CONDITIONS.—Protective spasm or inflammation of muscles from carious teeth, gingivitis, mumps, or from cold.

Very rarely, in lesions of nucleus in pons, or irritation of nerve in basal meningitis.

Distinguish from osteo-arthritis and disease of jaw-joint.

2. Clonic Spasm ('Chattering teeth').—Rigors. General convulsions. Cold.

VIII. SPASMODIC TORTICOLLIS.

Spasm of the muscles of the neck, affecting position of head. No organic changes in the nervous system. The clonic type is a true tic.

Etiology.—

AGE.—Adults.

SEXES.—Equal: apparent excess in females is due to hysterical spasms.

PREDISPOSING CAUSES.—Neuropathic taint.

EXCITING CAUSES.—Debility; cold; disorders of vision; local injury. Often none.

Symptoms.—

ONSET.—Gradual. Increases in frequency and extent. Rarely sudden.

CHARACTER OF MOVEMENTS.—Two types: (1) Clonic: 'jerks'. At onset, occurs at long intervals: finally may be 20 to 30 per minute. Very distressing. (2) Tonic: position of head long maintained. Both types may occur in same patient.

As in other 'tics', initially under control of will, but effort exhausting. Tic is preceded by feeling impelling movement. Ceases in sleep. Increased by emotion. Sometimes controlled by antagonistic movement, e.g., finger pressed under chin. Discomfort considerable, rarely great pain.

MUSCLES.—Never waste; may hypertrophy. Electrical reaction normal.

TYPE OF MOVEMENTS.—

1. STERNOMASTOID CONTRACTIONS.—Commonest form: generally on right side. Draws mastoid towards shoulder, turning head to opposite side and raising chin. Usually associated, as disease progresses, with other muscles, e.g.: (a) Trapezius, upper part, movement similar; (b) Splenius of opposite side, tilts head backward. Arm (opposite side) or face occasionally affected.

2. 'RETRO-COLLIC SPASM'.—Deep posterior neck muscles. Head drawn back: forehead wrinkled and eyebrows raised, from occipito-frontalis contraction.

Rarely: Anterior neck muscles. Chin on chest.

Occasionally other muscles: complexus, scaleni, recti, platysma, omohyoid.

Course.—Chronic. Remissions; but permanent recovery rare. Life not shortened.

Diagnosis.—

CLONIC TYPE.—Simple, except from hysterical spasms.

TONIC TYPE.—From abnormal positions of head:—

CONGENITAL TORTICOLLIS.—See next page.

CERVICAL CARIES.—Other signs present.

HYSTERICAL SPASM.

Transient:—

FIBROSITIS, myositis: 'stiff neck'.

INFLAMMATION, e.g., enlarged lymphatic glands or deep suppuration: pyrexia and other signs.

Spasmodic Torticollis, *continued*.

Treatment.—As in other 'tics'. Remove local irritation. Mental rest. Massage. Movements of head. Suggestion. Sedatives (avoid morphia).

OPERATION.—Best is resection of part of spinal accessory, together with division of posterior primary divisions of 4 or 5 upper cervical nerves on other side. Benefit often transient.

CONGENITAL TORTICOLLIS.*

Origin from birth; often unnoticed for several years. Probably due to congenital defect of centres in medulla; akin to congenital talipes.

Characteristics.—(1) *Head rotated to other side and chin raised*: sternomastoid shortened, hard and atrophied: usually right side.
(2) *Facial asymmetry*.

Diagnosis.—Rupture of sternomastoid at birth also produces contraction, but thickening palpable at site of rupture.

Treatment.—Tenotomy relieves torticollis: facial asymmetry permanent.

Section XII.—VASOMOTOR AND TROPHIC DISTURBANCES.

CHAPTER CLXXVI.

VASOMOTOR AND TROPHIC DISTURBANCES: TROPHONEUROSES.

I. RAYNAUD'S DISEASE.

A condition characterized by recurrent attacks of vascular spasm producing local syncope, terminating in gangrene in severe forms; usually affecting extremities, and generally bilateral and symmetrical. Probably due to a constitutional abnormality of the vasomotor mechanism.

Etiology.—

AGE.—First attack commonest in early adult life. No age exempt.

SEX.—Commoner in females.

HEREDITY.—Definite factor.

EXCITING CAUSE.—Cold is essential factor. Never occurs in warm climates.

PREDISPOSING FACTORS.—Syphilis sometimes a definite factor.

Gastric and intestinal disturbances may precede attack. Malaria and neuroses occasionally recorded.

Morbid Anatomy.—No constant changes. *Peripheral neuritis* not uncommon, but may be absent in typical and severe instances.

Pathogenesis.—The phenomena undoubtedly result from spasm of arteries and arterioles, probably also of veins: has been observed in the retina. Slight cold produces results in liable subjects resembling effects of intense cold on healthy persons. Origin is a disturbance of the vasomotor innervation, which is abnormally sensitive to cold. No sufficient evidence to locate site of abnormality, whether in (1) vasomotor nerve fibres in vessels and peripheral nerves, or (2) vasomotor centres in cord and brain.

Relation to Other Conditions.—Raynaud's disease is one of the 'trophoneuroses', a group of conditions which is unsatisfactorily ascribed to abnormality of the vasomotor mechanism. The group includes many rare and obscure conditions, the separation and classification of which are still very doubtful.

Raynaud's disease has sometimes been closely grouped with paroxysmal hæmoglobinuria, erythromelalgia, and angioneurotic oedema, it being claimed that these tend to coexist, or occur, in the same individual. With regard to this, note:—

I. RAYNAUD'S DISEASE AND PAROXYSMAL HÆMOGLOBINURIA.—Probably only with syphilis.

Raynaud's Disease—Relation to Other Conditions, *continued*.

2. RELATION TO ERYTHROMELALGIA.—Similarity occurs :
 (a) In hyperæmic stage of attack in Raynaud's disease, area being hot, throbbing, and vessels distended. (b) In later stages of chronic erythromelalgia, part may become blue and cold ; rarely gangrene occurs. Differences are :—
 RAYNAUD'S DISEASE.—(1) Commoner in females ; (2) Cold is exciting cause ; (3) Tends to be symmetrical and bilateral ; (4) Area blue and cold ; (5) Often paroxysmal.
 ERYTHROMELALGIA.—(1) Commoner in males ; (2) Fatigue or heat excites onset. (3) Usually unilateral ; (4) Area red and hot ; (5) Often persists for years.
3. RELATION TO ANGIONEUROTIC OEDEMA.—This disease is connected with capillary permeability and with the group of conditions in which protein hypersensitiveness is a factor, e.g., bronchial asthma. There is no evidence that Raynaud's disease is related to these.

SUMMARY.—Evidence does not yet definitely connect erythromelalgia more closely than as diseases of similar tissues. The conditions described in this chapter probably fall into at least two divisions : (1) Vasomotor disturbances, e.g., Raynaud's disease ; (2) Connected with permeability of capillary endothelium and allergic phenomena, e.g., angioneurotic oedema. Position of many diseases is doubtful, e.g., Milroy's disease, sclerodermia, thrombo-angiitis obliterans, facial hemiatrophy, intermittent hydrarthrosis. (See also BRONCHIAL ASTHMA, p. 575.)

Symptoms.—Attacks are paroxysmal.

GENERAL CHARACTERS.—(1) Affects extremities (circulation lowest). (2) Resembles results of extreme cold. (3) Tends to be bilateral and symmetrical. Very rare except in winter. Recurrences common, may be yearly. Ill health, gastric or intestinal disturbances, may precede attack.

SITES AFFECTED.—These are, in common order : (1) *Upper extremity*. Fingers first, especially index ; rarely extends to wrist. Occasionally, areas in forearm. (2) *Lower extremity*. Toes first ; rarely above ankles. (3) *Ears*. (4) *Nose*. Rarely : tongue, nates.

STAGES.—

1. LOCAL SYNCOPE.—From vasoconstriction (spasm) of arteries and arterioles, no blood enters area, which becomes white ('dead fingers'). Feeling of numbness, some stiffness and impairment of sensation. Returns to normal through asphyxia and hyperæmia. Duration, few minutes to hours.
2. LOCAL ASPHYXIA.—Colour of area blue to almost black. May follow stage of syncope, but in severe forms often blue from onset. Ascribed to blood from veins flowing back into area before relaxation of arterioles. Affected area extremely cold, tender, and excessively painful.
3. ACTIVE HYPERÆMIA.—Arteries and arterioles dilate widely. Area red, hot, swollen, throbbing, and painful. Gradual return to normal.

4. **GANGRENE.**—If previous stages, with local cessation of circulation, be sufficiently severe and prolonged, natural sequence is necrosis of tissue, i.e., gangrene. Area becomes black, very cold, and very painful. Small bullæ with blood-stained fluid common. Gangrene usually (i) bilateral and symmetrical, (ii) dry, (iii) final loss of tissue small and usually superficial, e.g., end of one finger.

DEGREES OF SEVERITY.—

1. **MILD ATTACKS.**—Acrocyanosis, from spasm, followed by stages of asphyxia and hyperæmia and return to normal. All stages, white, blue, and red, often simultaneously present in different fingers or areas of one extremity, also patches of cedema. 'Chilblains' form a mild type.
2. **MODERATE ATTACKS.**—Area becomes permanently blue, in asphyxia; then gangrene follows and loss of tissue, e.g., tip of a finger. Pain extreme.
3. **SEVERE ATTACKS.**—Large area affected, e.g., both hands and both feet. Attacks often recurrent, and final loss of tissue extensive. Rare.

Complications.—Generally referable to vascular spasm, or to vasomotor phenomena.

1. **PAROXYSMAL HÆMOGLOBINURIA.**—*See above*, and also p. 712. Following are all rare:—

2. **CEREBRAL SYMPTOMS.**—Transient aphasia; transient hemiplegia; epileptic fits.
3. **TEMPORARY AMBLYOPIA.**—From spasm of retinal vessels.
4. **SKIN.**—Urticaria. Rarely sclerodermia.
5. **ARTHRITIS.**—Effusion into joints. Occasionally fibrous ankylosis.

Albuminuria occasionally.

Diagnosis.—Usually simple. Moderate forms from syringomyelia, peripheral neuritis, cervical ribs.

GANGRENE of extremities occurs also in: senile gangrene, diabetes, advanced arteriosclerosis, thrombo-angiitis obliterans.

MULTIPLE AREAS OF GANGRENE rarely follow acute fevers, e.g., typhus, typhoid, malaria, and treatment with gold.

Treatment.—

PROPHYLAXIS.—Warm clothes. Sufficiency of fat in diet, and tonics. Careful attention to digestion and bowels. Avoid washing cold hands in hot water. Wintering in warm climates usually a complete preventive.

Drugs.—Thyroid. Calcium lactate and glucose. Vitamins. Acetylcholine under trial.

Soak extremities night and morning in water at 98° to 99° for ten minutes.

If Wassermann reaction positive, usual antisyphilitic treatment.

DURING ATTACKS.—Wrap part affected in cotton-wool. Protect from injury. Pain may need morphia.

SURGICAL.—Ramisection; extirpation (or alcohol injection) of sympathetic periarterial network or ganglia. Results of vasodilatation: immediate results often striking, but always transient.

II. ERYTHROMELALGIA.*(Red Neuralgia.)*

"A chronic disease in which a part or parts—usually one or more extremities—suffer with pain, flushing, and local fever, made far worse if the parts hang down" (Weir Mitchell). Rare disease.

Etiology.—

AGE.—Begins usually in middle age, or later.

SEX.—Commoner in males.

EXCITING CAUSES.—Fatigue, and hanging down limb. Hot weather. No hereditary factor apparent. Local injury may precede onset.

Morbid Anatomy.—Small arteries and veins are thickened. No evidence of peripheral neuritis.

Pathogenesis.—Obscure. May be abnormality of vasomotor centres or of blood-vessels themselves.

Note.—

1. In arsenical neuritis, similar condition may occur. Rarely in syringomyelia, myelitis, tabes, disseminated sclerosis.
2. In intermittent claudication, similar condition may occur and gangrene follow.
3. Thrombo-angiitis obliterans accounts for at least some recorded cases.

Symptoms.—

SITE.—Most commonly one foot: rarely extends above ankle. Occasionally bilateral. Rarely hands and face.

ONSET.—In hot weather. Burning pain in sole after walking, recovers on rest; then with recurrent attacks affected area becomes red, hot, slightly swollen; arteries throbbing, veins enlarged; pain extreme. Surface temperature higher than on unaffected areas. No pitting.

Condition eased by elevation or cold: aggravated by hanging down or heat.

PROGRESS.—*Chronic condition* may develop. Part later may become blue and cold, and gangrene follow. Agonizing pain wears out patient.

Treatment.—At onset, cold applications and elevation for many weeks. Cold climate advisable. Pain may necessitate morphia. Ramisectomy, division of posterior roots of lumbar and sacral nerves, is contra-indicated.

III. ANGIONEUROTIC ŒDEMA.*(Giant Urticaria. Quincke's Disease.)*

A condition characterized by the sudden occurrence of œdematous swellings of local extent and of short duration.

Etiology.—Occurs at any age and in either sex. *Heredity* frequent; through many generations. Neurotic factor in some forms, especially women at menopause.

Symptoms.—

ONSET.—Sudden. Occasionally preceded by local itching and heat.

CHARACTERS.—Local œdematous swelling: firm, rarely pits, definite outline.

SITE.—Hands, face, feet, and genitals commonest.

DURATION OF SWELLING.—Transient, often few hours; rapid disappearance. Frequently recurs in a different site.

GENERAL SYMPTOMS.—Frequently (1) gastro-intestinal disturbances, e.g., colic; (2) joint pains, may be swelling.

ŒDEMA OF LARYNX.—Often fatal. Constitutes essential danger.

BLOOD.—No change. Platelets normal.

Prognosis.—Œdema of the larynx often rapidly fatal (in absence of tracheotomy.) Usually swellings gradually cease in weeks or months. Attacks of coma occasionally occur: may be very transient, but sometimes fatal: probably due to cerebral œdema (often mistaken for uræmia).

Treatment.—*During attack:* Inject adrenalin hydrochloride (1 in 1000) 5 to 10 min. *Between attacks:* Ephedrine gr. $\frac{1}{2}$ b.d. or t.d.s. Try thyroid, calcium lactate. Protein shock with T.A.B. vaccine. Condition often obstinate. (See also HÆMORRHAGIC DIATHESIS, p. 723)

Trophoneuroses with Œdema.—Angioneurotic œdema is characterized by the paroxysmal escape from the vessels of the fluid constituents of blood. It is essentially due to permeability of capillary endothelium, as in HÆMORRHAGIC DIATHESIS (p. 717), and akin to Henoch's purpura. Œdema is less understood, being more difficult to observe, than escape of blood and less serious in not producing anæmia and exhaustion of hæmopoietic tissues, while fluid escaping can be reabsorbed or replaced. General considerations include:—

1. Condition may be: (a) Primary: (i) Hereditary, familial; (ii) Acquired. (b) Secondary: Numerous causes, external and internal, e.g., 'sting', various foods and drugs, injections of serum.
2. Successive attacks may be (a) identical, (b) alternate with purpura or other skin manifestations, (c) local or general.
3. Relations to hæmorrhagic diathesis are close in certain forms, viz.: (a) Attacks may be interchangeable; (b) Complications are similar, except anæmia, e.g., colic, joint pains, nephritis.
4. Relations to protein hypersensitiveness: Certain forms undoubtedly are connected, e.g., with anaphylaxis, bronchial asthma.
5. Relations with various allied skin lesions, e.g., erythema multiforme.

IV. HEREDITARY OEDEMA OF THE LEGS.

(*Milroy's Disease. Chronic Trophædema.*)

A condition characterized by chronic œdema of the legs without obvious cause.

Chief Characters.—

1. May be hereditary or *sporadic*. Commonest in females. Usually obvious about puberty. May be initially unilateral.
2. No obvious cause.
3. Chronicity. Condition permanent.
4. Swelling usually of lower extremities, pits slightly on pressure, finally great hypertrophy. Swelling circumscribed, and foot may escape. Weight causes discomfort. Partly subsides at night.

Acute periods occur with fever and increased swelling due to lymphangitis (cf. ELEPHANTIASIS, p. 213).

Progress.—œdema increases and extends up trunk. Sepsis is a serious complication. Cardiac weakness develops and obscures original condition. Death from cardiac failure not uncommon about middle age in sporadic cases.

Treatment.—Bandage legs. Rest gives temporary improvement only.

Note.—Condition may be due to lymphatic defect. On theory of block in pelvic lymphatics, skin grafts from thigh to flank have been made.

V. FACIAL HEMIATROPHY.

A rare condition of unknown origin, characterized by slow progressive unilateral wasting of the tissues of the face, the muscles being least affected.

Etiology.—*Onset* in childhood: rarely in adults. Females commonest. *Predisposing factors*: slight injuries, acute infectious fevers: may be none. *Heredity* slight.

Pathogenesis.—Probably connected with 5th nerve, developmental or possibly morphœa. May be extreme neuritis of 5th nerve.

Characteristics.—(1) Strictly unilateral. (2) Onset insidious and progress slow. (3) Commences in an area or areas of skin with local wasting. (4) Extends gradually: involves fat and subcutaneous tissue until entire side of face affected. (5) Hair may whiten or fall out. (6) Bones: growth retarded, or atrophy and teeth fall out. (7) Tongue: may be hemiatrophy. (8) Facial muscles: little or no affection, except loss of fat. No sensory or electrical changes: may be slight tingling. Rarely: bilateral, or extends to upper limb. *Course*: progressive to a certain stage and then stationary: no effect on life.

Diagnosis.—From: (1) Congenital torticollis with asymmetry; (2) Localized scleroderma. Also from atrophy of hemiplegia, acute poliomyelitis, nuclear lesions.

Treatment.—Massage and electrical treatment.

VI. ERYTHROEDEMA.*(Pink Disease.)*

An acute affection of young children, of unknown origin, characterized by peripheral vascular manifestations and reddening of the skin, often described as polyneuritis and erythema, by mental depression, and by constitutional disturbances.

Etiology.—Age: 4 months to 4 years. No predisposing causes known: no evidence of infectivity, or of vitamin deficiency.

Morbid Anatomy.—Peripheral neuritis and lymphocytic infiltration of cord.

Symptoms.—

ONSET.—Insidious. Pyrexia and coryza. Temperature falls.

PROGRESS.—Extremities itch. Palms and soles appear red and sodden: cold to touch and poor circulation. Skin reddens. Lies on side, limbs flexed. Intense depression and misery. Anorexia. Insomnia. Sweats profuse. Thirst constant.

SKIN.—Diffuse reddening: face and limbs most affected: red, swollen, intensely irritable: varies from day to day. Desquamation follows.

NERVOUS SYSTEM.—Hypotonia extreme: no true paralysis.

Knee-jerks diminished. Hair may fall out.

Leucocytosis common. Cerebrospinal fluid: no change. Urine: nil.

Prognosis.—Good. Duration: 3 to 9 months. Death rarely from inanition or intercurrent disease.

Treatment.—Symptomatic.

VII. LIPODYSTROPHIA PROGRESSIVA.

A rare disease of unknown origin commencing in childhood, characterized by progressive symmetrical loss of subcutaneous fat in the face, neck, thorax, arms, and abdomen, with relative or absolute abundance of fat over pelvis and lower limbs.

Note.—It is uncertain in what section this disease should be placed.

Etiology.—Females commonest, at least 2 to 1. No hereditary, familial, congenital, or racial factors.

Pathogenesis.—Unknown. No evidence of endocrine disturbance or error of fat metabolism. Only pathological change is diminution of subcutaneous fat.

Characteristics.—

1. *Onset* usually at 5 to 8 years. Previously healthy.
2. Face thin, wrinkled, cadaverous, and intensely pale. Upper limbs and trunk: extreme loss of fat. Pelvis and legs normal or increased fat. Breasts normal.
3. Skin shows normal texture. Bones normal.
4. No muscular weakness. No sensory changes. Reflexes normal. Health good. No anæmia.

Section XIII.—DISEASES OF THE MUSCLES, JOINTS, AND BONES.

CHAPTER CLXXVII.

DISEASES OF THE MUSCLES.

I. MYOSITIS.

Inflammation of muscles, usually confined to voluntary muscles.

Classification.—

PRIMARY.—

1. SUPPURATIVE MYOSITIS.—Very rare.
2. DERMATOMYOSITIS.—Very rare.

SECONDARY.—

1. SUPPURATIVE MYOSITIS.—In pyæmia, etc.
2. TRICHINELLA SPIRALIS.
3. ACUTE SPECIFIC FEVERS.—Mainly degeneration, e.g., Zenker's degeneration, most common in enteric.

Rarely:—

4. Syphilitic.
5. Tuberculosis.

SPECIAL CHRONIC DISEASES.—

1. MYOSITIS OSSIFICANS.—(a) Local; (b) General and progressive.
2. MYOSITIS FIBROSA.

FIBROSITIS AND MYOSITIS.—See p. 1087.

PRIMARY SUPPURATIVE MYOSITIS.

Mainly recorded in Japan. Sudden onset, constitutional disturbances, muscles swollen and tender, with subsequent abscess formation. Various pyogenic organisms isolated.

DERMATOMYOSITIS.

Onset gradual or sudden, with constitutional disturbances: pyrexia and enlarged spleen.

Characteristics.—(1) *Muscles* swollen and tender: few escape. No abscess formation. (2) *Dermatitis* of various types, œdema, urticaria, purpura, erythematous or erysipelatous eruptions.

Morbid Anatomy.—Parenchymatous and interstitial inflammation of muscle.

Pathogenesis.—Allied to urticarial, purpuric, and similar conditions.

Diagnosis.—From trichiniasis, only by removal of portion of muscle, or possibly by X rays.

Prognosis.—Usually fatal, from respiratory disturbances.

Clinical Varieties.—A hæmorrhagic form occurs. Neuromyositis: sensory changes described.

MYOSITIS OSSIFICANS PROGRESSIVA.

A generalized, irregular, progressive ossification of voluntary muscles. Distinguished from ossification of a single muscle, e.g., 'rider's bone'.

Etiology.—Onset in early infancy. *Males* commoner. *Microdactyly* of thumb and great toe common. Pathogenesis unknown.

Symptoms.—Commences in muscles of back and neck. *Four stages*, proceeding simultaneously in different sites: (1) Acute attacks of pain and swelling of muscles, subsiding in few weeks. (2) Attacks recur and fibrosis follows, forming local tumours. (3) Ossification develops in tumours after further attacks, irregular masses gradually coalescing into shapes 'like coral': still movable on deep tissues. (4) Bony masses become adherent to bones, producing absolute immobility. Aponeuroses, tendons, joints, etc., become affected. Few or no voluntary muscles unaffected.

Course.—Progresses by recurrence of acute attacks. Finally, after years, unable to move or masticate. Death from intercurrent diseases.

Diagnosis.—Early stages: from injury or rheumatism. Later stages: from congenital multiple exostoses.

Treatment.—Palliative.

MYOSITIS FIBROSA.

Very rare. Fibrosis of muscles, commencing in early life, usually in lower extremities, progressing gradually to contractures and immobility: no ossification occurs; joints unaffected.

Pathology.—Great increase of fibrous tissue.

Diagnosis.—From acute arthritis of children, myopathies, and cerebral degias.

Treatment.—Massage, movement, and electricity: recovery under treatment is recorded.

II. FIBROSITIS.

(*Myalgia. Myositis. Lumbago and other types.*)

A painful condition of various voluntary muscles, due to inflammation of fibrous tissue of the insertions, sheaths, and periosteal attachments. May also affect sheaths of nerve-trunks and fibrous tissue elsewhere.

Etiology.—As in OSTEO-ARTHRITIS (see p. 1092).

Fibrositis, continued.

Pathology.—Inflammatory hyperplasia of fibrous tissue with proliferation of fibroblasts and local exudations of serum. These exudations may resolve and be absorbed spontaneously or as a result of treatment; or they may organize, forming nodules, condition then becoming chronic or with frequent recurrences.

Symptoms.—

ONSET sudden. Various local sites attacked in different types. Constitutional symptoms absent or very slight. Pain severe: acute severe spasm on contracting affected muscles, especially suddenly: may be dull ache in interval. Muscles often tender; may be indurated, especially in neck.

DURATION.—Few days to weeks.

RECURRENCES.—Very common.

Types.—

LUMBAGO.—Affects lumbar muscles. *Onset* usually absolutely sudden, with or without causal strain. *Pain* extreme on contracting back muscles, e.g., on regaining erect position after stooping. Patient walks slowly with rigid back. Muscles in spasm and tender. Nodules often palpable in lumbar muscles. Recurrence very common.

Diagnosis, in recurrent or persistent attacks, from: sacro-iliac disease, caries, arthritis, or rarely spinal tumours.

PLEURODYNYA.—Affects intercostal muscles: unilateral. *Pain* extreme.

Diagnosis from pleurisy, intercostal neuralgia (no tenderness of nerve-trunks).

STIFF NECK: ACUTE TORTICOLLIS.—Very common in children, following draughts or strained position of neck. Muscles tender and often indurated.

Treatment.—

INDICATIONS.—(1) Rest; avoid muscular contractions. (2) Relax muscular spasm. (3) Disperse and promote absorption of exudation to prevent organization into nodules.

REST.—In bed. Local rest assisted by strapping, but interferes with treatment.

HEAT.—Relaxes muscular spasm. Hot-water bottle; electrical pad. Diathermy.

MASSAGE.—Commence with light massage; then deeper after few days to disperse nodules and indurations.

FARADISM. MANIPULATION. PASSIVE MOVEMENTS.

DRUGS.—As in osteo-arthritis.

SPA TREATMENT.—In chronic cases.

Panniculitis.—Local inflammation of subcutaneous tissue; becomes thickened and adherent to skin. Tender to touch. Large nodules may form. Regarded by some authorities as fibrositis, but more probably akin to local areas occurring in adiposis dolorosa.

CHAPTER CLXXVIII.

RHEUMATOID ARTHRITIS.

Etiology.—Age at onset: 20 to 40 years. Females predominate.

Pathogenesis.—Uncertain. No relation to gout or rheumatic fever. Appearance of joints suggestive of septic or toxic origin, but foci usually not found, and when present, removal may not affect progress. May follow repeated pregnancies.

FOCI OF SEPSIS.—Following sites to be examined and treated: Teeth; tonsils; prostate; nasal sinuses; gall-bladder. Colon doubtful.

Morbid Anatomy.—Changes are initially *peri-articular*.

1. **EARLY 'EXUDATIVE' STAGE.**—Thickening of synovial membrane and peri-articular tissues; main cause of enlargement of joint. Effusion variable. Red vascular villous outgrowths of synovial membrane. Cartilage and bone of joint at onset little affected; later, vascularization and absorption. Rarefaction of bone (decalcification) is early and *generalized* but most advanced near affected joints.

.. **'ATROPHIC' STAGE.**—Thickened synovial membrane atrophies and fibroses. Cartilage and articular surfaces destroyed, commencing at site of pressure of synovial membrane. Fibrous adhesions between surfaces. Proliferation of bone slight, may be a few spicules; no definite osteophytes.

Muscular atrophy severe near joints.

Note.—Changes of osteo-arthritis superimposed in long-standing cases.

Symptoms in Early 'Exudative' Stage.—

ONSET.—Often transient attacks in fingers, wrists, and toes.

Tends to be *bilateral and symmetrical*. Onset acute or subacute.

PAIN.—Variable, often severe. Slight at rest but severe on movement. Worse at night. Partly due to muscular spasm.

CONDITION OF JOINTS.—*Fusiform* swelling, due to swollen joint and wasted muscles. Skin appears sodden, but little redness. Swelling mainly of peri-articular tissues; may be some synovial effusion.

JOINTS AFFECTED.—Order of frequency: (1) Hands and feet; proximal interphalangeal and metacarpophalangeal joints.

(2) Wrists. (3) Ankles. (4) Knees. Temporomaxillary joint and cervical vertebrae also very common. No joint immune.

TEMPERATURE.—In acute onset, occasionally 102° to 103° , subsides to 100° , and may persist for weeks. Often much slighter.

Pulse in proportion to temperature.

LIMITATION OF MOVEMENT.

MUSCULAR WASTING AND CONTRACTURES.—Early and rapid.

GENERAL FEATURES.—Loss of weight. Fatigue.

Rheumatoid Arthritis, *continued*.

Symptoms in Late 'Atrophic' Stage.—Swelling diminishes and becomes less fusiform. Muscular wasting extreme and contractions marked. Subluxation of joints common. Results in deformity, fixation, ankylosis, and loss of function in joints. Trophic changes in skin and nails. Pain may subside, but spasms in limbs often troublesome. Rarely this syndrome occurs as primary type.

Diagnosis.—

1. RHEUMATIC FEVER.—Often very difficult. In rheumatoid arthritis: (i) Little or no response to salicylates; (ii) Smaller joints commoner, pain and tenderness rarely very severe; (iii) Does not subside in one joint when commencing in another; (iv) Temporomaxillary joint and neck often affected; (v) No endocarditis; (vi) Subsequent joint changes.
2. OSTEO-ARTHRITIS.—By appearance of joints and radiographs.
3. TUBERCULOSIS.—By appearance of joints and radiographs.
4. GONORRHOEA.—Very difficult. In gonorrhoea: (i) History and presence of gonococci; (ii) Small joints less common; (iii) Often wanders from one joint to another, but specially injures one. Joint hot and oedematous.
5. GOUT.—In gout: (i) Commoner in men; (ii) Onset sudden; (iii) Great toe and thumb especially; (iv) Joint 'swollen, red, shiny, and oedematous'; (v) Pain severe. In chronic gout, more difficult: usually previous acute attacks.
6. TENOSYNOVITIS.—Creaking over tendon, joint change slight, pain increased on movement.
7. CHARCOT'S JOINT.—Sudden painless swelling, much effusion, evidence of syphilis.

Radiograph.—Especially: (1) Rarefaction of bone near joints; (2) Proximity of joint surfaces owing to destruction of cartilages. No lipping or osteophytes.

Prognosis.—Acute stage tends to wear out, leaving permanent changes. May be recurrences. Osteo-arthritis may be superimposed later.

Treatment.—

GENERAL.—General health important. *Septic foci* to be removed or treated (wholesale dental extraction inadvisable).

DRUGS.—*Analgesic*: salicylates. *Local to joints*: methyl salicylic ointment or Scott's dressing.

LOCAL TREATMENT.—Acute inflamed joint to be rested and not to bear weight. Splint in optimum position (in case joint becomes fixed); may have to be reached gradually by progressive alteration of angle of splint if joint already out of position. Splint removed and joints moved daily to prevent adhesions: movement active if possible, otherwise passive: one movement in each direction, repetition contra-indicated.

MASSAGE AND FARADISM.—To muscles moving joint, to control wasting.

GOLD TREATMENT.—Crisalbine, sanocrysin. *Dosage*: weekly injections, 0·01 gm. increasing to 0·05 gm.; total 1 gm. Many good results. *Dangers*: jaundice, diarrhoea, stomatitis, nephritis; exfoliative dermatitis; many serious effects have occurred.

VACCINE THERAPY.—No evidence of scientific basis or specific practical value. Protein shock may occur with good or bad result.

SPA TREATMENT.—Contra-indicated in acute stages.

RHEUMATOID ARTHRITIS IN CHILDREN.

(*Still's Disease.*)

General Characters.—

ONSET.—Insidious usually: less often acute. Age 3 to 6 years at onset.

JOINTS.—Enlarged. Swelling 'fusiform', mainly of peri-articular tissues, characters resembling acute peri-articular type. Muscular wasting severe, and limitation of movement.

LYMPHATIC GLANDS.—Enlarged. Generalized enlargement, usually of considerable size: may increase during exacerbations.

SPLEEN.—Often palpable.

TEMPERATURE.—Often persistently about 100°. Sweating common.

PROGRESS.—Slow advance, with exacerbations and pyrexia. Anæmia, wasting, debility, and lack of development. Heart unaffected. Intercurrent diseases often fatal.

Note.—Several rare and obscure groups of arthritis and joint changes occur in children. Their relation to and differentiation from Still's disease has been little studied. (See LATE RICKETS, p. 384.)

ARTHRITIS SECONDARY TO ACUTE INFECTIONS AND OTHER CAUSES.

Includes the following groups:—

1. *Acute infections*: (a) Gonococcus, pneumococcus, tuberculosis, streptococcal and staphylococcal infections; (b) Undulant fever, typhoid, typhus, dengue, cerebrospinal fever, bacterial dysentery, measles; (c) Rheumatic fever, scarlet fever, tonsillitis.
2. Urticaria, hæmorrhagic diathesis, hæmophilia.
3. Allergic and anaphylactic—e.g., serum disease.
4. Metabolic—e.g., gout.
5. Deficiency diseases—e.g., rickets, scurvy.
6. Trophic—e.g., syphilis, syringomyelia.
7. *Intermittent hydrarthrosis*. A rare and obscure condition. Characterized by periodic rapid swelling of joints; little pain; subsides in 2 to 3 weeks. Knees commonest. Joints usually normal in intervals even after numerous attacks. May continue many years. May be œdema elsewhere. Possibly allied to urticaria, or anaphylactic. General health unaffected, but neuroses common. No effective treatment.

CHAPTER CLXXIX.

OSTEO-ARTHRITIS

Osteo-arthritis may develop in joints as result of: (1) Trauma; (2) Exposure to wet and cold; (3) Secondary to rheumatoid arthritis and other forms of arthritis; (4) Old age; (5) Various indefinite factors, e.g., endocrine deficiencies, general debility.

Influence of septic and toxic factors not obvious. Dental defects common. Achlorhydria frequently associated.

Onset and progress is chronic.

Etiology.—Age at onset: 40 to 60 years. In general forms, females predominate. In spondylitis and mono-articular forms, males commoner.

Morbid Anatomy.—Changes essentially in cartilage and bone of joint.

CARTILAGE cells proliferate, capsules burst into joint; ground substance thus divided into filaments and devoid of cells. Cartilage has velvety appearance, wears away, and exposes bone.

BONE, exposed, hardens on surface and has ivory appearance (eburnation); grooves form from movements of surfaces and cause 'crepitus'. 'Osteophytes' form at edges, proliferation of cartilage cells producing accumulations which ossify, i.e., 'lipping' of joint, and, by interlocking, render joint immobile. Hypertrophy of bone also occurs. True bony ankylosis very rare, except in spine. Atrophy of bone is not a feature, but may be considerable in senile hip-joints.

SYNOVIAL MEMBRANE.—Thickens. Fringes may hypertrophy, become cartilaginous, separate, and constitute 'foreign bodies' in joint.

Symptoms.—

ONSET.—Chronic, rarely acute. Generally polyarticular. Exacerbations and gradual progress usual.

PAIN.—Variable. May be slight throughout. Sometimes severe.

CONDITION OF JOINTS.—Swelling tends to be nodular in shape, nearly confined to joint, and affection of peri-articular structures slight. Effusion rare.

JOINTS AFFECTED.—Distribution may be: (1) Polyarticular, either from onset or by subsequent extension: usually a few large joints, but no joint immune. (2) Mono-articular, especially vertebræ (spondylitis), hip-joint, and knee.

Constitutional symptoms slight. Temperature slight. No enlarged glands.

Advance and exacerbations occur until final development of characteristic condition.

Characteristics in Late Stages.—

1. **PAIN.**—Often in wet weather, but also when hot and dry. Worse at night.

2. **DEFORMITY OF JOINTS.**—Due to: (i) Osteophytes and overgrowth of bone ('lipping'). (ii) Absorption of cartilage and bone altering shape of joint-surfaces and angles of articulation. (iii) Thickening of capsule. (iv) Muscular contractures. '*Ulnar deviation*' characteristic: due to affection of metacarpophalangeal joints.
 3. **LIMITATION OF MOVEMENT.**—From locking of osteophytes, fibrous adhesions, and causes of deformity. Bony ankylosis very rare except in spine.
 4. **MUSCULAR WASTING.**—Constant, but not extreme. Reflexes are increased. Cause doubtful.
 5. **CREPITUS ON MOVEMENT.**—Fine in early stage; coarse later. From apposition of bony surfaces and formation of grooves.
- SKIN.**—Often glossy. Trophic changes in nails. Occasionally pigmentation.
- PALLOR** usual, and some anæmia.

Radiographs.—(i) Osteophytic outgrowths: new bone formation. (ii) Irregular loss of joint space. Rarefaction of bone slight or absent.

Final Condition.—Patient may become helpless, at which stage condition often quiescent and painless. Not infrequently small joints of hands escape when large joints are severely affected, and vice versa.

Heberden's Nodes.—Small bony swellings, usually on distal side of terminal interphalangeal joints: apparently from tubercles on insertion of extensor tendons. Commoner in women. May be first sign of arthritis. Similar bone swellings occur in gout, though rarely.

Diagnosis.—Usually simple.

HIP-JOINT.—From tuberculosis (rotation specially affected) and sacro-iliac disease.

SPONDYLITIS.—From tuberculous or pressure caries (compression myelitis).

SHOULDER-JOINT.—From neuritis and subdeltoid bursitis.

Treatment.—See p. 1095.

MONO-ARTICULAR TYPE.

Hip-joint (*Morbus Coxæ Senilis*).—

ETIOLOGY.—Usually males, over 40 years. Injury common cause. Generally unilateral.

SYMPTOMS.—

PAIN.—Slight at first; may remain so or become severe. Worse after excessive exercise and towards evening. May be felt in joint, groin, knee, thigh, or buttock (suggesting sciatica).

LIMITATION OF MOVEMENT.—Early: mainly muscular stiffness from spasm. Later, from joint changes. Rotation, abduction, and adduction affected before flexion and extension.

MUSCULAR WASTING.—Especially thigh and buttock.

Osteo-arthritis of Hip-joint—Symptoms, *continued*.

DEFORMITY.—Early: limb abducted and externally rotated; pelvis tilted down, causing apparent lengthening. Lordosis develops. Later: limb adducted. True shortening subsequently from atrophy in head and neck of femur.

RADIOGRAPHS.—Early: often negative. Peri-articular lipping appears first. Later: narrowing of joint interval; atrophy and changes in bone.

PROGNOSIS.—Tends to advance in affected joint, but often remains localized.

SPONDYLITIS DEFORMANS.

Forms of arthritis in which the spine is chiefly and severely affected.

Types.—These are two in number:—

1. **STRUMPEL-MARIE'S 'SPONDYLOSE RHIZOMÉLIQUE'.**—Possibly distinct both from rheumatoid arthritis and osteo-arthritis.
2. **OSTEO-ARTHRITIS OF THE SPINE.**—Including von Bechterew's type.

Spondylose Rhizomélique.—

ETIOLOGY.—Onset from early adult to middle age.

PATHOGENESIS.—Unknown: bacterial toxins suspected, but no evidence and small joints noticeably escape.

MORBID ANATOMY.—Earliest change: epidural exudate, of waxy appearance, deposited on arches and bodies of vertebræ. Ossification invades this exudate, also intervertebral discs and ligaments of vertebræ and neighbouring joints, including sacro-iliac and costo-vertebral (latter affecting respiration). Commences usually in lumbosacral region. Rarefaction of bone severe, with softening. No osteophytes.

SYMPTOMS.—Gradual progress, with intermissions, to complete ankylosis of spine and large joints, shoulders, and hips. May be straight 'poker-back' or various deformities. Kyphosis may cause chin to touch sternum. Smaller joints mostly escape.

PAIN severe in early stages, due to attempted movements; absent when ankylosis complete, except rarely from pressure on nerve-roots.

DIAGNOSIS.—Simple in late stages.

Osteo-arthritis of the Spine.—Ordinary changes and etiology of osteo-arthritis. Osteophytic formation often extensive. Complete ankylosis rare. Exostoses may press on nerve-roots, causing pain, paræsthesia, and muscular atrophy: known as von Bechterew's type (he believed spinal meningitis to be initial lesion).

TREATMENT OF OSTEO-ARTHRITIS

GENERAL.—Reduces obesity. Treat septic foci.

DRUGS.—*Analgesic*: salicylates. Many others in use with beneficial effects, e.g., iodine and iodide, guaiacum and sulphur ('Chelsea pensioner'). Cincophen (atophan): use with caution (*see* Gout).

LOCAL TREATMENT TO JOINTS.—Heat eases pain temporarily and relaxes muscular spasm—e.g., hot air, immersion, mud, diathermy.

EXERCISE.—Exercise, short of fatigue, beneficial. Aggravation of pain or pain at night is evidence of excess and need for rest.

PASSIVE MOVEMENTS.—Useful, harmful if excessive. Preferably in conditions which exclude weight-bearing, e.g., in bath.

MASSAGE.—Benefits nutrition of muscles. (Useless to muscles of ankylosed joint.)

ELECTRICAL TREATMENT.—Various measures in use—e.g., infra-red rays, ultra-violet rays, ionization, deep X-ray therapy. Value dubious.

SPA TREATMENT.—Beneficial in chronic cases, from routine and opportunities for systematic treatment.

SURGICAL TREATMENT.—Indicated for freeing adhesions and correcting deformities in suitable cases.

CHAPTER CLXXX.

DISEASES OF THE BONES.*

I. HYPERTROPHIC PULMONARY ARTERIOPATHY.

A symmetrical enlargement of the bones of the extremities of the limbs, with 'clubbing' of the terminal phalanges. Associated with certain diseases, especially of the lungs: never primary. Very rare.

'Clubbing of the Fingers' (*Hippocratic fingers*).—An initial and allied condition. Very common.

DESCRIPTION.—Terminal phalanges swollen and rounded. Nails enlarged and curved in both directions. Skin shiny. No pain. Toes also affected occasionally: usually congenital morbus cordis. Onset usually gradual. Rarely in two weeks in empyema: may disappear after treatment.

ETIOLOGY.—

I. CONGENITAL MORBUS CORDIS. — Common. Not in acquired cardiac lesions.

* See also RICKETS, OSTEOMALACIA, LEUCO-ERYTHROBLASTOSIS, GENERALIZED OSTEITIS FIBROSA.

Clubbing of the Fingers—Etiology, *continued*.

2. DISEASES OF THE LUNGS.—(i) Bronchiectasis; (ii) Phthisis, especially with cavities; (iii) Empyema. Rarely in abscess of lung, emphysema, etc. In aneurysm, rarely: sometimes unilateral.

Described (but doubtful) in certain other conditions, rarely, e.g., congenital syphilis, chronic jaundice, chronic diarrhoea.

MORBID ANATOMY.—Thickening of fibrous tissues, and distension of vessels. No bony changes.

Hypertrophic Pulmonary Arthropathy (*Marie's syndrome*).—

DESCRIPTION.—(1) Hands and feet large. (2) Clubbing of terminal phalanges invariable. (3) Forearm thickened near wrist; to less degree long bones near ankle. Rarely: enlargement at knee and elbow-joint. Occasionally kyphosis. Condition symmetrical: less in lower extremities. Slight stiffness of joints. May be tenderness, but no redness or actual pain. Onset gradual, usually unnoticed by patient.

ETIOLOGY.—As in clubbed fingers, except that occurrence in morbis cordis is *extremely rare*. Commoner in males.

MORBID ANATOMY.—Proliferation of bone under periosteum (an ossifying periostitis), causing enlargement. Rarefaction of deeper bone tissue. Synovial membrane may thicken.

PATHOGENESIS.—Obscure. Allied condition of clubbing often ascribed to congestion. Marie's theory: periostitis due to toxins: not improbable. Other theories include: tuberculous periostitis (many authorities); neuritis and oedema (now discarded).

SITES AFFECTED.—Usual are: lower ends of ulna, radius, tibia, and to less degree fibula, also metacarpals and metatarsals. Carpal and tarsal bones escape. Rarely, lower end of femur and humerus, and patella. Face never affected.

DIAGNOSIS.—Usually simple. Clubbing of fingers and primary disease invariably present. Radiograph shows bony changes. Skull never affected. Diagnosis, rarely difficult, from acromegaly, osteitis deformans, arthritis deformans. Condition does not influence prognosis as to life.

II. OSTEITIS DEFORMANS.

(*Paget's Disease.*)

A chronic disease of bones occurring in later years, producing softening, new formation, and subsequent hardening; and resulting especially in enlargement of the head, curving of the spine, and curving and enlargement of the bones of the legs. Rare disease.

Etiology.—*Age*: rarely under 50 years. Some evidence of heredity. No relation to parathyroid disease: blood calcium and phosphorus normal (phosphatase high), but error of mineral metabolism possible.

Morbid Anatomy.—(1) Early stages (resorption of bone): bones softer and become more vascular, hence *curvatures* from pressure. (2) Later (excessive apposition of bone): deposits of osteoid tissue both in medulla and also, markedly, under periosteum, mainly along normal ridges. (3) Finally, calcification of new bone.

BONES AFFECTED AND RESULTING CHANGES.—

1. SKULL.—Great enlargement. Thickness $\frac{1}{2}$ to $\frac{3}{4}$ inch.
 2. SPINE.—Kyphosis.
 3. TIBIA.—Great thickening and bowing: convexity forwards. Changes less marked in femur. Pelvis broadens. Clavicles, thick and deformed. Ribs fall in.
- Face, hands, feet little change. Upper extremity less than lower.

Symptoms.—*Onset* insidious: often first noted by friends. General health good.

Early noticeable phenomena: (1) Head enlarging. (2) Bowing of legs. (3) Stature shortening (from kyphosis and curvature of legs).

Condition developed: Forehead prominent and face appears small (thus differing from acromegaly). Spine bent, and chin held forward. Legs bowed, with enlargement, often enormous, of tibiae. Sometimes thickening of clavicles, thorax fallen in, and abdomen prominent.

Radiographs.—'Cotton-wool' appearance: due to decalcification and new osteoid tissue. Later, enlargement.

Variations.—Occasionally is painful. Changes may be confined to tibia and fibula. Osteosarcoma occasionally, but not common. Various bone tumours and cysts described, but may be confusion with osteitis fibrosa.

III. LEONTIASIS OSSEA.

Hyperostoses of cranial and facial bones. Extent and distribution variable; occasionally superior maxillæ affected alone, or other bones of body affected also, but less severely. Formation of dense new bone results in: (1) Large, grossly deformed head. (2) Severe pains, blindness, deafness, etc., from obliteration of foramina, pressure on and destruction of nerves, and reduction in size of cavities, e.g., orbit and mouth.

Very rare. Onset about 30 years. Progress slow. Possibly a variety of osteitis deformans.

IV. OSTEOGENESIS IMPERFECTA.

(*Fragilitas Ossium. Osteosathyrosis. Lobstein's Disease.*)

A defect commencing in intra-uterine life characterized by abnormal brittleness of bones, due to failure of membrane and periosteal bone-formation, and resulting in numerous fractures.

Osteogenesis Imperfecta, continued.

Description of a Fœtus.—Characterized by: (1) Body proportions and length of bones fairly normal. (2) Bones brittle or soft, sometimes can be bent. (3) Numerous intra-uterine fractures; callosities at site of union. (4) Cranium development defective. (Some of the callosities are possibly abnormal bone-formation, and not results of fractures.)

Etiology.—Origin unknown. Heredity often recorded. No relation to syphilis.

Morbid Anatomy.—Basal defect is inability to produce osteoblasts. Cartilage bone-formation unaffected, hence no shortening of bone, and body proportions normal. Subperiosteal and membrane bone-formation defective, consequently cortex is thin, and bones brittle and easily fractured. (Pathology is thus converse of achondroplasia, in which membrane bone-formation is normal, and endochondral ossification is defective.)

Symptoms.—General health unaffected. Fractures occur with extreme ease, and unite rapidly. Tendency present from birth, and usually ceases about 30 years of age. Subsequent life depends on deformities from repeated fractures.

CRANIAL OSSIFICATION.—Abnormal: extreme bitemporal protuberances common, also frontal and occipital; may be numerous Wormian bones.

ASSOCIATED DEFECTS: (1) Blue sclerotics—hereditary; (2) Otosclerosis; (3) Lax joints and dislocations. Also cataract.

BLOOD CALCIUM AND PHOSPHORUS.—Normal, but high excretion.

Treatment.—No specific. Phosphorus. Protection against injury.

NOTE.—*Abnormal fragility of bones* also occurs in old age, insanity, various bone lesions (e.g., syphilis, sarcoma, and secondary tumours), conditions causing decalcification, rickets, scurvy, tabes, and phosphorus poisoning.

V. ACHONDROPLASIA.

(*Chondrodystrophia Fœtalis.*)

An abnormality of cartilage bone-formation arising in foetal life, resulting in deficient growth of long bones. Surviving subjects are dwarfs with short limbs and long bodies.

Etiology.—Sexes equal. Usually sporadic but rarely hereditary. Patient may die at birth or in infancy; in others life is not shortened.

Characteristics.—

1. DWARFS.—Height 3 to 4 feet.
2. EXTREMITIES VERY SHORT.—*Especially femur and humerus.*
3. TRUNK about normal.

4. HEAD.—Appears large. Forehead prominent. Face small with pug-nose. (Vault normal, base shortened.)

5. 'TRIDENT HAND'.—Fingers of equal length and diverging.

OTHER FEATURES.—*Sacrum* tilted forward, whence : (1) Pelvis contracted ; (2) Apparent lordosis, but spine actually very straight ; (3) Abdomen prominent. *Limbs* bowed and bent owing to abnormal articulations and not to curving of bones. *Feet* large and flat, tissue round ankle in folds. *Acetabula* set far back, hence nates prominent. Soft tissues thick, and overgrown for length of bones, hanging in folds. Various congenital deformities, e.g., hypospadias, not infrequent.

General features.—If surviving first year, general virility marked (normal heart in small body). Mental development normal or quaint. Muscles and bones very strong. Sexually precocious. Often gymnasts or public entertainers.

Bones Mainly Affected (in order of severity).—(1) Femur and humerus ; (2) Tibia and ulna ; (3) Base of skull. Symmetrical distribution. Radius and fibula less affected, hence articulation of joints set at abnormal angles. Bones are abnormally hard, no softening.

Morbid Anatomy.—Essential change is deficiency of *endochondral ossification* (cartilage bone-formation), due to abnormality of epiphysal cartilages. Line of ossification is straight, but narrow (see RICKETS, p. 380). Zone of cartilage cell-proliferation shows characteristic changes (doubtful which is primary) :—

1. Cartilage cells irregularly arranged and *very scanty*, i.e., aplasia.

2. Connective-tissue strands grow in from periosteum, and may completely separate shaft from epiphysis.

Ossification of epiphyses either retarded or premature : may be early union to shaft.

Periosteal bone-formation normal.

Pathogenesis.—Unknown. No relation to rickets or syphilis. No evidence of endocrine disturbance or abnormal mineral metabolism. Disturbance of amniotic pressure suggested, but improbable. Always commences in foetal life, apparently between third and sixth month. Bones which are laid down in cartilage after this, and all membrane bones, escape almost, but not completely.

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